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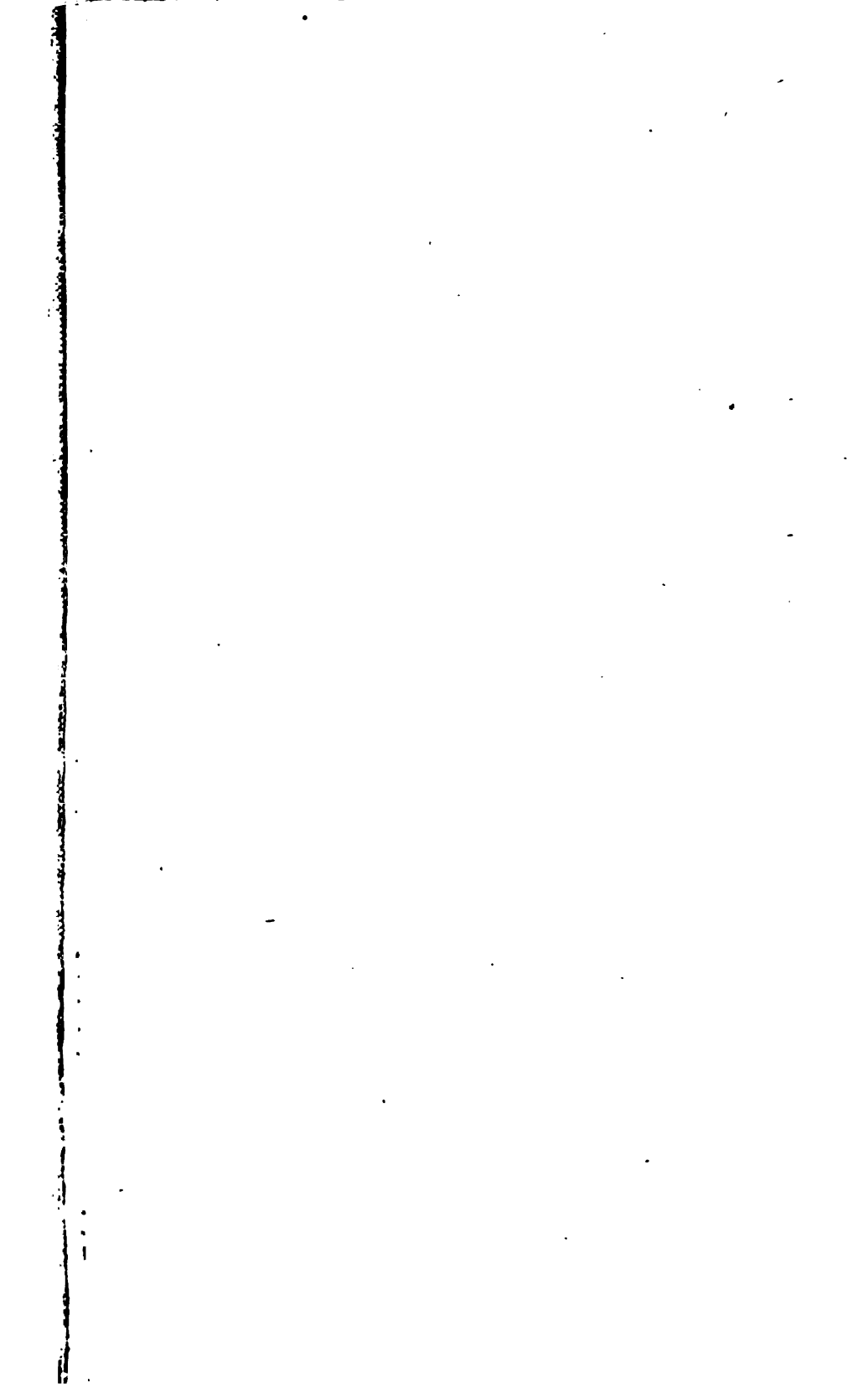


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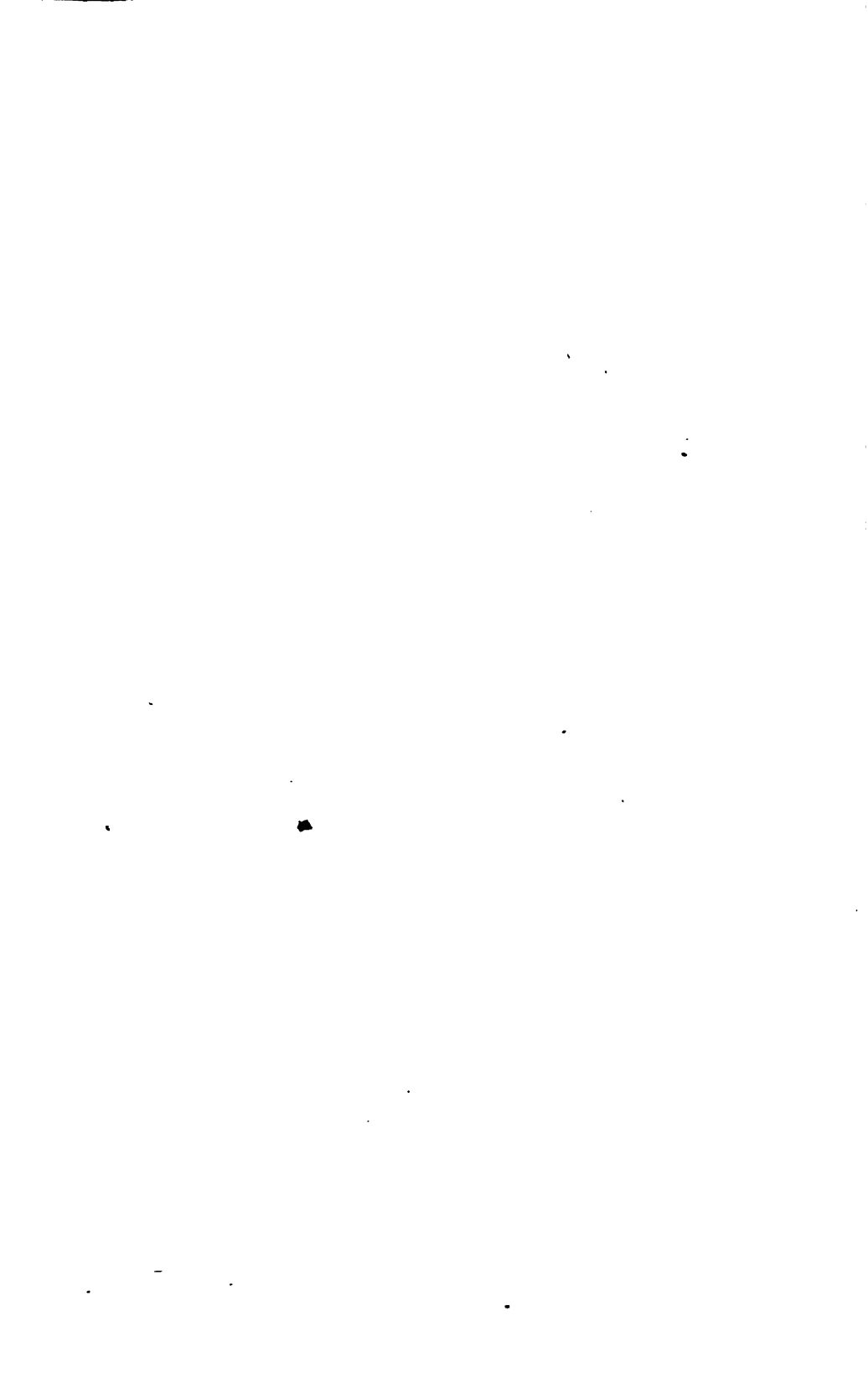


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Vol. I.

No. I.

BULLETIN

OF THE

CHICAGO ACADEMY OF SCIENCES.

GLACIAL MARKINGS OF UNUSUAL FORMS

IN THE

LAURENTIAN HILLS.



By EDMUND ANDREWS, M. D., LL.D.

CHICAGO:

C. H. BLAKELY & CO., PRINTERS, 88 DEARBORN STREET

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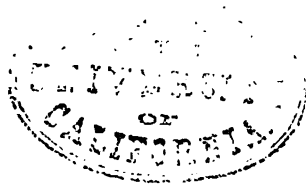
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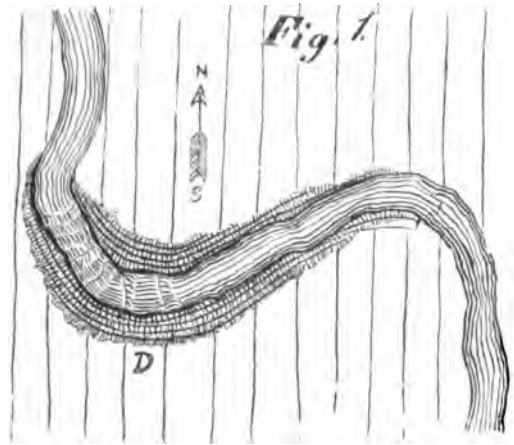
BY EDMUND ANDREWS, M. D., LL.D.

Two summer vacations spent in camps and canoes where the Laurentian Hills skirt the northeast shore of Lake Huron, have brought to my notice some glacial phenomena of very unusual forms.

These hills are for the most part ranges of hard metamorphic rock, which at the boulder drift period were scraped bare and washed clean of all earthy covering, so that the present forests grow mostly in a thin stratum of vegetable mold of later origin. The irregular and knobby eminences, as the country slopes gradually beneath the level of Lake Huron, project their countless summits above the water in a wide belt of wooded islands, which extend along the coast some two hundred and fifty miles. The British chart (Bayfield's original) marked fifty-two thousand of these islands. The rocks along the coast are mostly white quartzite and gneiss, and are everywhere covered with glacial markings which are often of peculiar forms. North and northeast of Grand Manitoulin Island the Cloche Mountains stretch east and west about thirty miles along the coast. These mountains are of white quartzite, and the strata are nearly perpendicular, with the strike parallel to the range, that is, east and west. They are covered everywhere with striations which, owing to the intense hardness of the material, retain their forms with beautiful distinctness.

CURVED STRIÆ.

Among the interesting phenomena of the region are the thousands of curved striations. Fig. 1 is from the stream that comes down by



the Hudson's Bay Post, about fifteen rods above the cascade. There is a broad gap here in the Cloche range, through which some fine lakes lying behind the mountains send their surplus waters to Lake Huron. The stream apparently ran in the same bed before the drift period, for the little gorge at D, (indicated in the figure

by shading,) scarcely ten feet deep, is well scored to the very bottom with glacial striæ following all the sinuosities of the stream. The general course of the striæ of the gap is southward. The perpendicular lines in the figure indicate this general direction, while the curved lines in the shading of the gorge (D) show how the striæ bend abruptly in order to follow around the hard quartzite banks of the stream, and, in doing so, even run a little contrary to the main course of the glaciation.

The crest of the Cloche Mountains is crossed by a multitude of giant grooves, some of which reach a depth of six feet and are twenty feet across. These markings run southward, rounding slightly over the summit of the range and down its slopes, until they reach the crests of its southern precipices, where they terminate abruptly, as it were sailing away into the air and not forming any grooves down its face.

Sixty miles southeast of the Cloche gap, and off the mouth of French River, there lies outside of the general insular belt a beautiful cluster of wooded islets, the Bustard Isles. The group consists of about two hundred *roches moutonnées*, upon which sufficient vegetable mold has accumulated to support a growth of trees. Wherever this soil has been washed away by the waves, the striæ come to view.

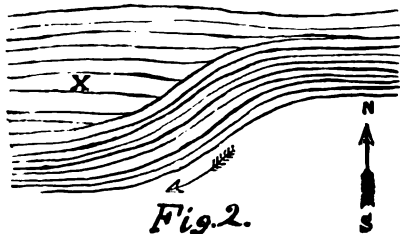
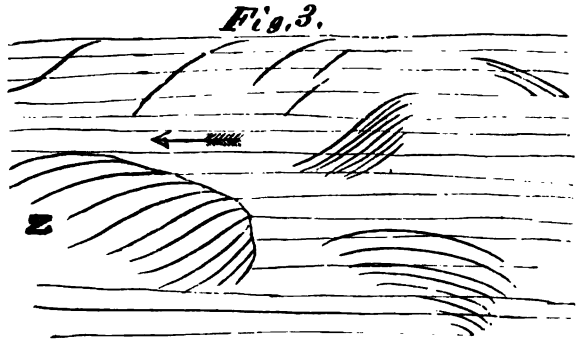


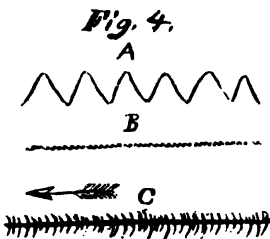
Fig 2 was sketched from a sample of curved markings near one of my camps on the north side of the group. The sketch represents about fifteen feet of the length of the marks. It is not easy to see any reason for the curve, as there was no prominence of rock in the direction of *x* to turn the ice. In fact the islet was highest on the side toward which the ice turned at the first curve. The compass-mark is approximately, but not precisely correct.

Fig. 3 is copied from my notes of observation on striæ found at Negaunee, in northern Michigan. A knob of rock uncovered by iron-miners was of such material that it showed on its irregular surface the finest markings, even to hair-lines.

There were upon this rock some curves, which were evidently deflections caused by knobs and bosses on its surface, as for instance at *z*, while other markings were erratic, and curved without obvious cause, as though the ice had been swayed by swirling currents as the waters moved about it. The most of the glaciation was in the direction shown by the horizontal lines. The curved lines in the figure were selected from hundreds of others on a surface of about two rods square. They were generally short, and some of the curves were of less than one foot radius.



SERRATED STRIÆ.



Behind the Cloche Mountains the Spanish River runs westward into Lake Huron. A branch of this stream, called the Sable, coming down from the hills on the north, presents near its mouth five cataracts within a distance of eight miles. At the lowest of the falls the river runs through a sort of rock flume, having upon both sides walls about forty feet in height, not quite vertical but with a slight inclination away from the stream. These cliffs are smooth and striated in every part parallel to the stream. At the falls, which are only a few

feet in height, the striæ curve with the descent, and also laterally with a bend of the cliff. On the walls of the gorge are to be seen a few examples of the marks A and B, fig. 4, and the mark A is serrated, the serrations being perhaps twelve inches high.

It is not easy to explain the cause of these striæ in a perfectly satisfactory manner, but it would seem that some of the ice must have been driven through the flume with a rocking motion, so that the boulders on its lateral margins were caused to take a zigzag course, scoring the walls in a corresponding form. In B, fig. 4, is represented a section of certain marks produced in the same manner as those cuts of a stone-planing engine where the tool trembles or vibrates in the grasp of the machine so as to cut a finely serrated groove. In the specimens found the serrations were about one-quarter of a centimetre from crest to crest. It is possible that the regular vibrations there recorded on the rocks had some fixed mathematical relation to the velocity of the ice, which might be determined by calculation or experiment.

NEW INDEX OF THE DIRECTION OF MOTION.

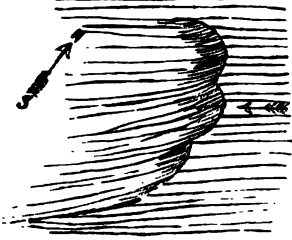
The mark c, fig. 4, was copied from a granite *roche moutonnée*, at the fishing hamlet of Killarney, near some quartzite ranges named "Killarney Mountains." Striæ of this type show a multitude of minute cracks, extending laterally and curved so as to present their points forward in the direction of the glacial movements. Only large grooves and scratches show this peculiarity. It is a very convenient mode of determining the direction of the motion, for the pressure of the boulders which made the scratches as they moved forward, caused the transverse crevices to present their concave sides always forward. It is well known to engineers that in brittle substances the forms assumed by fracture vary with velocity of the impact, so that there is probably a time relation involved here also, which would make it possible to determine the approximate velocity of the ice which carried the boulders. Such a calculation, if based upon carefully repeated experiments, might prove an important contribution to our scanty knowledge of the Drift Period.

SCOOP-MARKS.

These are singular phenomena, and very difficult of explanation. They are of two varieties, the striated and the unstriated. Fig. 5 is a diagram intended to illustrate a typical form of the striated variety. The marks consist of shallow, elongated excavations, or troughs,

which may be many feet in width. They run nearly in the direction of the general striation of the locality, and look as though a huge

Fig. 5.



flour-scoop had been inserted into the rock and had cut out enough of its substance to make a smooth and rather shallow concave channel. The end toward the east or northeast, from whence the drift action came, is abrupt, sharply defined, and, although the angle of junction with the general surface is obtuse, yet this line of junction is a sharp and clearly-cut edge, and

not a gradual sloping or rounding into the general level. The interior of the concavity is well striated in the direction of its own length, but the scratches are never continuous with those of the general surface northeast of the head of the scoop-mark; and conversely the striæ of the general glaciated surface are all cut off abruptly at the head of the scoop, and never descend at all into it.

The tail of the channel grows shallower as it runs west or south-westward, and its thin extremity merges imperceptibly into the glaciated surrounding surface.

A few of the scoop-marks are nearly flat in contour, and are only recognizable where they cut abruptly through at an obtuse angle into the general face of the rocks. The interpretation of these anomalous scoop-marks is somewhat perplexing. At least, after considerable study of them, I am quite unable to frame a plausible theory of their origin other than the general one, that ice was the agent.

The unstriated scoop-marks differ considerably from the others in form, and on the average are smaller, seldom exceeding two feet in breadth. There are no glacial markings in their smooth but unpolished concavities.

Fig. 6.

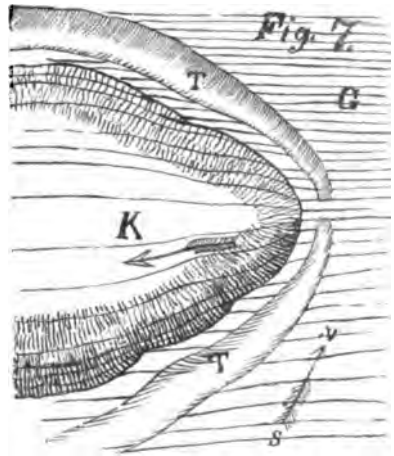


Whether they never contained any striations, or whether the markings have been erased by sand and water driven through them before the Drift Period closed, is not easily determined. These channels generally are crooked, without obvious reason (see Fig. 6), and are narrowest at the end toward the northeast, from which direction the drift came. Toward the opposite extremity they grow wider and more shallow,

disappearing finally and vaguely into the general ice-marked surface of the locality. The specimen shown in fig. 6 is, perhaps, six feet long, sunk in granite, without any crevice, vein or visible irregularity in the rock face to account for its excavation at that spot. These channels often differ pretty widely in direction from the adjacent striation, and the end nearest the northeast commences as a rounded depression, without the clear-cut edge presented by the striated scoop-marks. The darkly shaded spot in fig. 6 was deeper than the rest, as if from a species of "pothole" action.

Most of the striated scoop-marks are not independent phenomena, like fig. 6, but evidently are appendages to adjacent knobs and projections of rock. The type of such cases is represented in fig. 7, which is a diagram of the plan of numerous specimens seen along the eastern shore from Killarney to Parry Sound, a distance of about one hundred miles. K is a boss or knob of rock projecting above the general glaciated surface in an oval form, in fact a *roche moutonnée*. The specimen in fig. 7 is about four feet high, fifteen feet wide and thirty long, but the sizes of others vary without any obvious rule. The observed specimens are mostly in gneiss. The horizontal lines in the diagram show the general direction of the striation in the locality — nearly west-southwest as shown by the arrow. It will be seen that as the striæ approach and rise upon the surface of the knob they are deflected to the right and left, and sweep over it in an oblique course. This sort of curved deflection, partly over and partly around obstacles, is common to the whole coast, so that in many places almost all the striæ are curved by the influence of the knobby surfaces of the gneiss and quartzite.

T T are two unstriated scoop-marks, having a length of about ten feet and a width of twelve inches. They begin vaguely near to each other, but not in contact, close to the northeast end of the knob, and rapidly deepen to six inches or more as they curve about its two sides, after which they grow wider and more shallow until they become lost in the general glaciation along the sides of the rocky buttress. There are no striæ in these concavities, and their inner



borders do not touch the base of the knob, but keep a foot or more away from it, leaving a narrow strip of level striated rock between the margins of the troughs and the eminence.

In a multitude of cases, just as in this one, it is sufficiently clear that the resistance offered by knobs of rock to the progress of the drift agencies in some way determined the presence and direction of these scoop-marks.

The great belt of fifty-two thousand islands, above referred to, varies from three to fifteen miles in width, and is about two hundred and fifty miles long. Beginning at the Ste. Marie river, it first outlines the north channel by the great Manitoulin group, and thence passing southeast through Frazer Bay, continues along the whole east coast of Georgian Bay and terminates near Collingwood.

Near the mainland, the islands are mostly metamorphic, with a very distorted stratification, but a few of those on the lakeward border of the belt are of Silurian limestone, with the strata dipping gently away from the nearest metamorphic hills.

This almost untrodden solitude, which has lain forgotten by the crowds of summer pleasure-seekers, is well worthy of a visit by the lover of nature. The magnificent panoramas of the island belt, as viewed from the summit of the LaCloche and Killarney ranges, are unique, and in themselves well worth the journey to the region. Fortunately, they are as yet almost unknown to sight-seers, and still remain in their original freshness and silence.

NO. 6 EAST SIXTEENTH STREET,
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BULLETIN

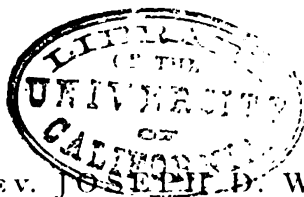
OF THE

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OBSERVATIONS ON FLUVIATILE DEPOSITS

IN

PEORIA LAKE, ILLINOIS.



BY REV. JOSEPH D. WILSON.

CHICAGO:

C. H. BLAKELY & CO., PRINTERS, 65 & 70 WABASH AVENUE.

1883.



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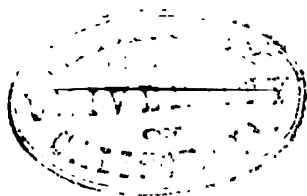
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PEORIA LAKE ILLINOIS.

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All running water wears away the land over which it flows; that is, it removes particles of soil, sand, etc., to lower levels. It does this in three ways:

FIRST. By taking into itself soluble matter and depositing it by evaporation.

SECOND. By holding in suspension particles of small specific gravity while itself in a state of agitation, and laying them down when it comes to a state of rest.

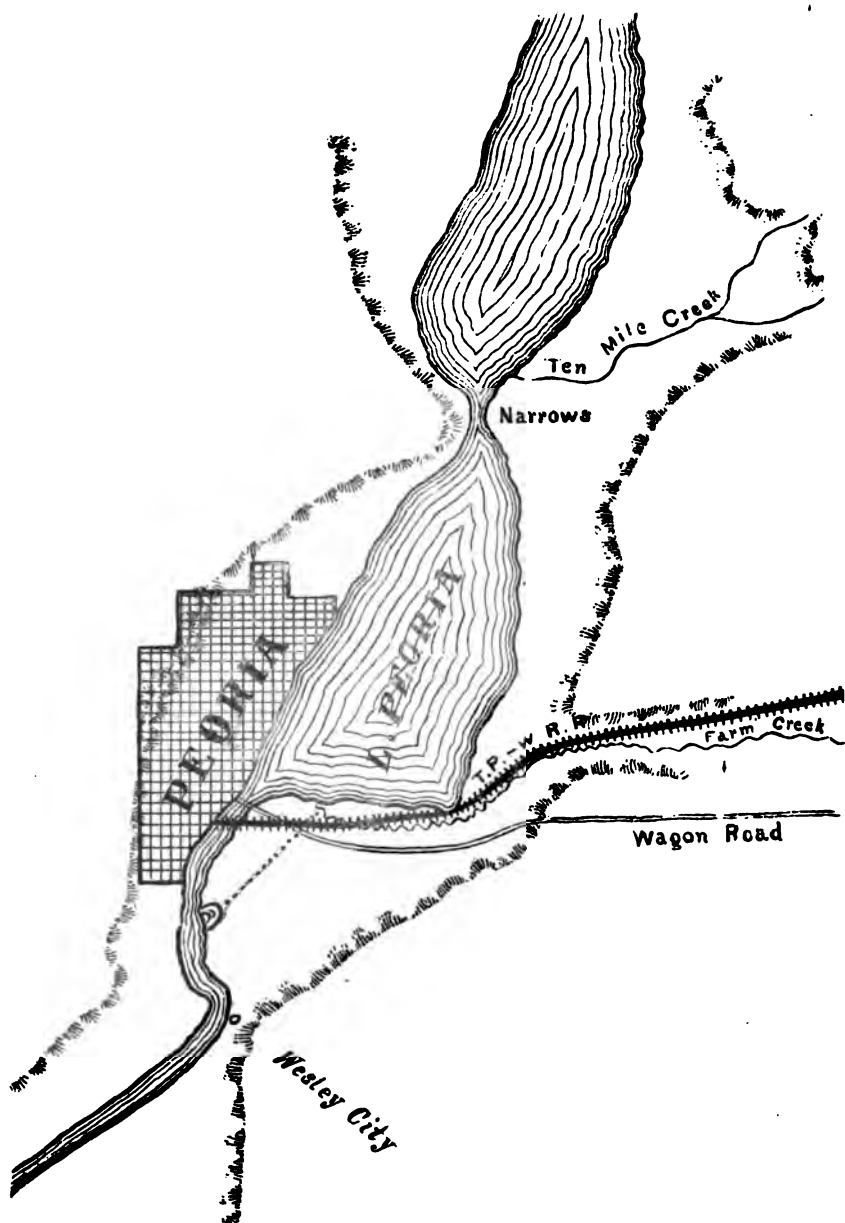
THIRD. By rolling or pushing heavier substances, sand and gravel, along the bottom, until bars or counter-currents prevent a further flow.

While erosion is going on in the upper levels, land is formed in the lower. The denudation being widely extended, is not ordinarily noticeable, and the land formation frequently goes on unobserved for considerable time, being under water, and not until navigation is interfered with, or the made land emerges above water, do we suspect the amount of work which is done by even a small stream.

The stream works all the time, day and night, and whether its waters be clear or muddy it is always doing something to level the hills and fill the ocean bed.

The following pages are a record of the work done by a little stream which falls into Lake Peoria, opposite the city of Peoria. Close observations were made during the years 1876, '77, '78, and occasional records and observations from 1867 to 1876 were obtainable.

Lake Peoria is an expansion of the Illinois River. What is known by the name of Lake Peoria is about fifteen miles long, and in ordinary stages of water about two miles wide. The lake is divided into two portions, the lower portion being four miles long



and separated from the upper lake by the "Narrows," a strait 500 feet wide. This paper deals with the lower lake. Except in high water there is no perceptible current in the lake, but the rapid flow in the constricted and shallow "narrows" and at the outlet shows that a current does exist. Being comparatively quiet, however, facilities are afforded for the deposit of the burden of mud and sand which Farm Creek has until recently been carrying into it.

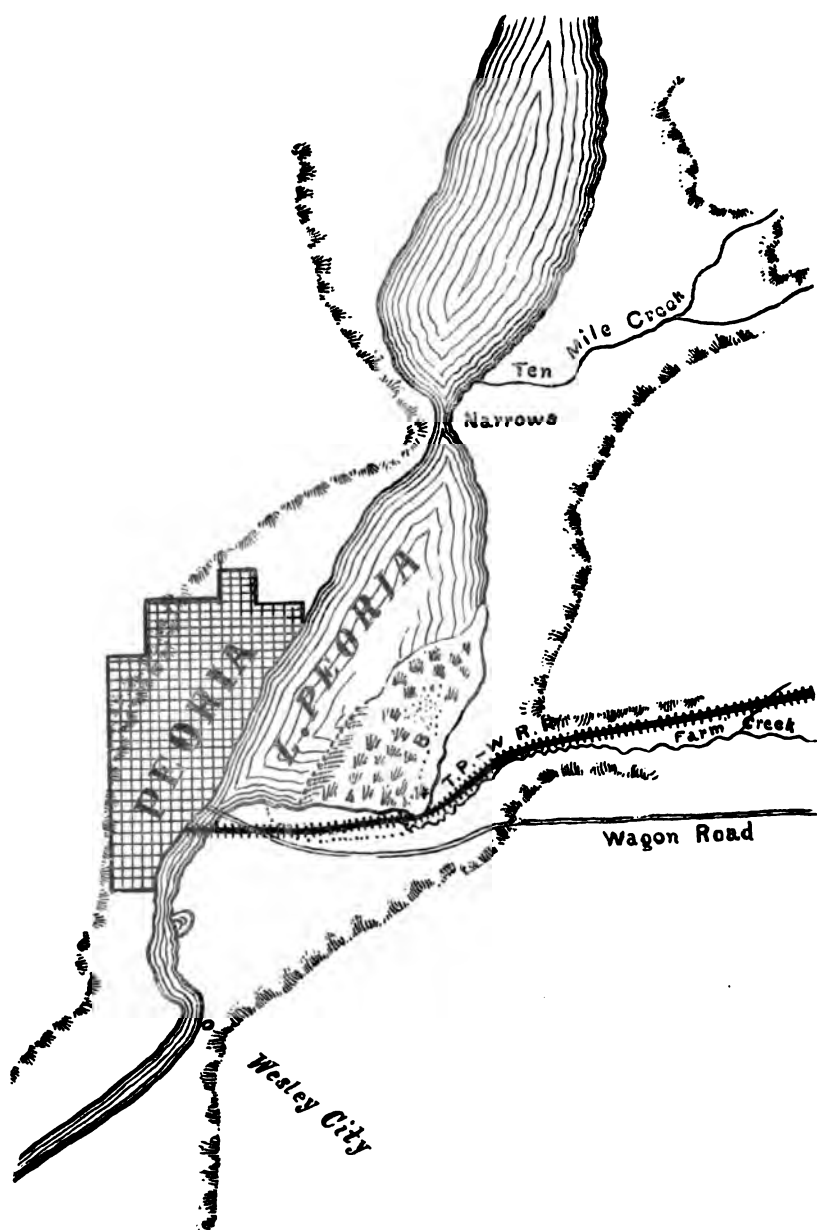
Whatever filling up of the bed of Lake Peoria has been done is the work of Farm Creek. In the high water of spring some silt is, of course, brought down from the upper Illinois, but at least an equal quantity is carried off by the Illinois River below, but generally the upper lake acts as a settling reservoir, and the water which flows through the narrows is comparatively clear. That the upper lake does act as a settling reservoir appears from the fact that no shoaling of the lower lake in its upper portion has been discovered since soundings have been made.

Prior to 1867, Farm Creek ran into the Illinois River through a channel shown by the dotted line in Map No. 1. Its point of *debouchement* into the river varied, but in general it sought the larger stream below the outlet of the lake.

In 1867 the Toledo, Peoria and Wabash Railroad was built. In that year, or afterwards, Farm Creek abandoned its old channel, and turning directly north emptied its waters into the lake.

The lake at that time extended in a line nearly east and west about two miles, and in the channel (500 to 1,000 feet from the Peoria shore) was twelve feet deep at low water. The lake deepened rapidly on the Peoria side, and very gradually on the Tazewell County or east side.

When Farm Creek turned its current directly into Peoria Lake, its waters were brought to rest at once and laid down their burden of sand and soil. A sand-spit formed at the mouth of the creek at the western or down-stream side. This sand-spit (shown in Map No. 2) extended northeast, and year by year grew longer and broader. As it broadened, the mouth of the creek shifted eastward. The creek piled up its sediment on the eastern side of the spit and rapidly filled that portion of the lake. In 1875 a fringe of willows appeared upon the spit, and by 1877 the whole of the newly made land east of the spit was covered with willows and cottonwoods. By this time the creek had crowded itself eastward until it ran close to the original Tazewell shore northward for a mile or more (dotted line B, Map No. 2). All the intervening space between the spit and the



Tazewell shore was now dry land at low water and covered by a dense growth of vegetation, which at high water sifted out whatever detritus was brought down by the creek, and thus raised the surface of the land still more.

In March, 1878, the creek filled its bed (B) and tore a channel for itself through the land it had produced, and running along the original south shore line emptied itself into the lake near the outlet.

In ten years time it had filled up the whole southeastern corner of the lake, reducing the width thereof at that place from two miles to 1,450 feet, and covering the bottom of one-third of the lake with six feet of mud.

In 1878 the citizens of Peoria had become so alarmed at the threatened destruction of their beautiful lake that they cleared out the original channel of Farm Creek and turned its waters into the Illinois below their city. A large portion of the lake has been hopelessly lost, however, and a miasmatic marsh, flooded in high water, lies over against that pretty town. About 1,000 acres have been taken from the lake and added to Tazewell County.

Besides this, the whole southern portion of the lake has shoaled from thirteen feet to less than six feet in the deepest part, and elsewhere in proportion. Diagram No. 3 shows a cross-section of the lake at 1,750 feet above the outlet. The section starts from the Peoria shore and runs eastward 3,200 feet. The imagination may protract the section. The lower line shows the bottom of the lake in 1867; the light shading shows the bottom in 1877 and the extent of water surface at low water.

Beginning at the wagon bridge at the outlet of the lake, a series of soundings in the deepest water was taken in 1867 by Col. D. C. Jennè. The following table will show the shoaling in 1877:

250 feet above bridge.	1867. feet.	1877. feet.
500 " " " " " " " "	6.	6.
1,000 " " " " " " " "	7.	5.9
1,500 " " " " " " " "	7.	5.45
2,000 " " " " " " " "	13.3	5.
2,500 " " " " " " " "	12.	4.45
3,000 " " " " " " " "	12.	4.6
3,500 " " " " " " " "	12.5	5.
4,000 " " " " " " " "	12.	5.68
4,500 " " " " " " " "	11.	6.5
5,000 " " " " " " " "	13.5	7.
5,500 " " " " " " " "	14.	7.
6,000 " " " " " " " "	11.	8.
6,500 " " " " " " " "	11.	9.
7,000 " " " " " " " "	11.	9.
7,500 " " " " " " " "	11.	9.
8,000 " " " " " " " "	11.	10.
10,500 " " " " " " " "	11.	11.

Peoria

500

2

1000

1500

3

2000

4

2500

3000

Tazewell 5

4

Soundings above this point show no especial change between 1867 and 1877.

From the above table it appears that the influence of Farm Creek ceased at about two miles up the lake.

A very moderate estimate will give 80,000,000 cubic feet of sediment brought down by this creek in ten years.

Now let us examine the active little stream which has done this work.

Farm Creek is fifty feet wide and three feet deep when full, which is only in freshets. In dry weather it shrinks so as to become almost invisible under its bed. It is difficult, therefore, accurately to determine its discharge, but we may approximate it.

It drains 44 square miles. Upon that country the rainfall averages 42 inches annually. This gives 4,200,000,000 cubic feet of water per annum. The creek cannot, therefore, discharge more than that amount. If we take 75 per cent. of the rainfall as the discharge, which is the usual estimate for the small tributaries of the Mississippi, we will have about 3,000,000,000 cubic feet of water brought down by this stream.

Observation confirms this estimate. When the creek was full it ran 300 feet per minute. When 11 feet wide it was 5 inches deep, and ran 98 feet per minute. When 7 feet wide it was 4 inches deep, and ran 100 feet per minute (having just then shortened its length by a mile).

Averaging all the observations of 1877-8, I find the theoretical estimate of 3,000,000,000 feet of water discharged per annum to be about correct. More than half of this discharge occurred in thirty days.

Thirty billions of cubic feet of water (ten years' flow) have, therefore, moved 80,000,000 cubic feet of sand and mud. The proportion of water to sediment is as 375 to 1.

This is a large proportion of sediment.

The River Po is said to move 1 proportion of sediment to 300 of water.						
"	Ganges		1	"	"	1,000
"	Mississippi	from	1	"	"	528
		to	1	"	"	3,000

Not all of the sediment moved by Farm Creek was held in suspension. I think that less than three-eighths was properly in suspension. The greater portion was rolled along the bottom. My crude experiments showed a proportion of 1,100 parts, of water to one of sediment. This would account for but 30,000,000 of the

80,000,000 of deposit. The remaining 50,000,000 have been pushed or rolled along the bottom.

One day I was witness of this pushing process. I had anchored my boat in the mouth of Farm Creek upon a sand shoal. The water was perfectly clear; nothing was held in suspension. But I observed that the whole bottom seemed alive. Rolling over each other, tumbling this way and that, but always down stream, leaping sometimes six inches at once, the grains of sand were all moving into the lake. This was in dry weather and the water was low — the current not more than 100 feet a minute. I saw then how water, while holding nothing in suspension, can yet effect important movements in the particles of its bed. This pushing process increases in energy, of course, when the stream becomes a torrent in floods, but it is a process which can go on in any flowing stream. Being unintermitted, the aggregate of its effect must be great. I do not hesitate to express my conviction that five-eighths of the work done by Farm Creek was done by the rolling of sand and mud along the bottom.

Farm Creek presents no unusual conditions. It is an ordinary stream flowing through prairie soil. There are thousands of such streams in the valley of the Mississippi. I apprehend that every one of them does as much in the way of erosion and land formation as Farm Creek, and that many changes which hitherto have been supposed to be the work of vast cycles of time have been the work of but a few years.

The above observations may be of service in solving the historic problem of La Salle's fort Crève Cœur.

On the 1st of January, 1680, La Salle landed at an Indian village on Peoria Lake. Shortly afterward he began the erection of a palisaded fort "on the left bank of the lake at its lower extremity."

The record both of himself and Father Hennepin, the priest who accompanied the explorers, are definite in giving the location as on the "left bank" and at the southern part of the lake. It is also stated that the fort was on a hill and commanded the approach by water up and down. This fort was named Crève Cœur, from the misfortunes which befel the heroic chevalier.

Historians have been at a loss to determine the site of this fort. By examining the accompanying maps it will be seen that there is no high ground anywhere along the southern shore of Lake Peoria. On the east, west and south the bluffs are a mile or more from the shore of the lake. At the northwest corner, overlooking the narrows, the bluffs do touch the lake, and a hill rises abruptly 100 feet

and more. Some have supposed that this must have been the site of Crève Cœur, and that the explorers must have meant the southern extremity of the upper lake. But unfortunately this point is on the *right* side of the stream and not on the *left*. Nothing can justify the supposition that La Salle, who had traversed the Illinois River from its source, did not know which way the water flowed. We must look on the opposite bank for the site of Crève Cœur.

One place answers the greater part of the conditions. It is a point two miles down the river at Wesley City. Here the bluff touches the river; an uninterrupted view is had up and down stream; it is on the *left* bank, and several hills suitable for defensive works against indians still exist. This position answers so well to the description given by La Salle that most historians have settled upon it as the site of Crève Cœur. But it is not on the lake; it is more than two miles south. The country between it and the lake is heavily wooded. Part of the land is low, but several hundred acres are in good farms. Various conjectures have been ventured to reconcile this location at Wesley with La Salle's statement that his fort was on the lake, such as that "two miles was so short a distance that La Salle would not mention it," or that "the river happened to be very high so that the limits of the lake were not well defined." But these conjectures are not satisfactory.

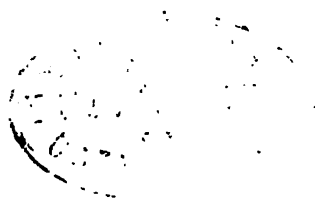
The true explanation appears to me to be that in La Salle's day Lake Peoria extended as far south as Wesley City. The whole intervening land, two and a half miles long by one mile broad, has been made by Farm Creek in the two hundred years since the French occupation.

1896
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No. III.

BULLETIN
OF THE
CHICAGO ACADEMY OF SCIENCES.

LIST OF BATRACHIA AND REPTILIA
OF
ILLINOIS.



By N. S. DAVIS, Jr., AND F. L. RICE.

CHICAGO:

C. H. BLAKELY & CO., PRINTERS, 68 & 70 WABASH AVENUE.

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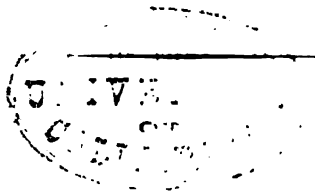
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The greater part of the following list was prepared for publication in 1876. The facts were collected by the authors and Mr. E. W. Nelson, to whom belongs equal credit in preparing the larger portion of the list. Since then, however, many additions have been made. A considerable number of species noticed below have not before been recorded as coming from this section of the country. There are quite a number also that, from their known distribution, we may expect to find in Illinois, but they have been excluded from the present list, as no well authenticated specimens from the State have come under the authors' notice. We wish to express thanks especially to Mr. Robert Ridgeway, Dr. P. R. Hoy, Prof. F. Stein and Dr. Schenck, for local lists which they have furnished us. The present list includes species and sub-species of—

Ophidia	54
Lacertilia	6
Testudinata.....	14
Total Reptilia.....	74
Trachystomata.....	1
Proteida	1
Caducibranchiata	17
Anoura.....	18
Total Batrachia	33
Total Reptilia and Batrachia	106

From this it is seen that nearly one-third of all the Reptilia and Batrachia of the United States are included in the fauna of Illinois.

BATRACHIA OF ILLINOIS.

TRACHYSTOMATA.

SIRENIDÆ.

1. *Siren lacertina*, Linn. Great Siren. Found throughout the Austroriparian region. A specimen in the collection of the Northwestern University was obtained in Northern Illinois.

PROTEIDA.

PROTEIDÆ.

2. *Necturus lateralis*, Say. Mud-puppy or Water-dog. Exceedingly abundant in Lake Michigan; found also in the Mississippi and other rivers throughout the State.

CADUCIBRANCHIATA.

MENOPOMIDÆ.

3. *Menopoma allegheniense*, Harl. Hellbender. Found in the Mississippi and its tributaries.

AMBLYSTOMIDÆ.

4. *Amblystoma talpoideum*, Holb. Mole Salamander. Found in the extreme Southern portion of the State.
5. *Amblystoma opacum*, Graven. Opaque Salamander. Abundant throughout the State.
6. *Amblystoma punctatum*, Linn. Large Spotted Salamander. Common in all parts of the State.
7. *Amblystoma tigrinum*, Green. Tiger Salamander. Exceedingly abundant everywhere.
8. *Amblystoma jeffersonianum*, Gr. sub-sp. *laterale*, Hall. Jefferson's Salamander. Found in the extreme Northern portion of the State.
9. *Amblystoma jeffersonianum*, Gr. sub-sp. *platineum*, Cope. A specimen in the collection of the Smithsonian Institution extends the Western range of this sub-species into Illinois.

PLETHODONTIDÆ.

10. *Hemidactylium scutatum*, Schl. Four-toed Salamander. Found throughout the State.
11. *Plethodon cinereus*, Gr. sub-sp. *cinereus*. Gr. Red-backed Salamander.

12. *Plethodon cinereus*, Gr. sub-sp. *erythronotus*. Gr. Both sub-species of this species are found in all parts of the State.
13. *Plethodon glutinosus*, Gr. Viscid Salamander. Common throughout the State.
14. *Spelerpes bilineatus*, Gr. Two-striped Salamander. Found throughout the State.
15. *Spelerper longicaudus*, Gr. Cave Salamander. From all parts of the State.
16. *Spelerpes ruber*, Daud.; sub-sp. *ruber*, Daud. Red Triton. Found throughout the State.

DESMOGNATHIDÆ.

17. *Desmognathus fusca*, Raf.; sub-sp. *fusca*, Raf. Dusky Salamander. Found in all portions of the State.
18. *Desmognathus nigra*, Gr. Black Salamander. A specimen in the collection of the Smithsonian Institution was found in Cook Co., Illinois.

PLEURODELIDÆ.

19. *Diemyctylus miniatus*, Raf.; sub-sp. *miniatus*, Raf. Red Evt. Common throughout the State.
20. *Diemyctylus miniatus*, Raf.; sub-sp. *viridescens*, Raf. Spotted Evt. Common in all parts of the State.

ANOURA.

BUFONIDÆ.

21. *Bufo lentiginosus*, Shaw; sub-sp. *americanus*, Le Conte. Common toad. Exceedingly abundant everywhere.

ENGYSTOMIDÆ.

22. *Engystoma carolinense*, Holb. Found in the extreme Southern part of the State.

HYLIDÆ.

23. *Acris gryllus*, Le C.; sub-sp. *gryllus*, Le C. Cricket Frog. From Southern Illinois.
24. *Acris gryllus*, Le C.; sub-sp. *crepitans*, Bd. Northern Cricket Frog. From the central and Northern part of the State.
25. *Chorophilus triseriatus*, Wied.; sub-sp. *triseriatus*, Wied. Tree Frog. Abundant in the Northern portion of the State.
26. *Hyla squirella*, Daud. Squirrel Frog. From Southern Illinois.

27. *Hyla pickeringi*, Holb. Pickering's Tree Toad. Not uncommon in the Northern portion of the State.
28. *Hyla versicolor*, Le C. Common Tree Toad. Abundant throughout the State.

RANIDÆ.

29. *Rana halecina*, Kal. Common Frog. Exceedingly abundant in all parts of the State. If the sub-species *halecina* and *berlandieri* are good, they are both found in the State.
30. *Rana palustris*, Le C. Pickerel Frog. Common throughout the State.
31. *Rana clamitans*, Merr. Green or Spring Frog. Abundant throughout the State.
32. *Rana catesbiana*, Shaw. Bull Frog. Common everywhere in the State.
33. *Rana temporaria*, Linn; sub-sp. *silvatica*, Le C. Found in all portions of the State. Abundant in the Northern part.
34. *Rana areolata*, B. & G.; sub-sp. *circulosa*. Ringed Frog. Specimens in the Smithsonian collections were obtained by Robert Kennicott in Northern Illinois.

REPTILIA OF ILLINOIS.

OPHIDIA.

CROTALIDÆ.

1. *Crotalus horridus*, Linn. Banded or Northern Rattle Snake. Found throughout the State. Abundant in certain localities.
2. *Caudisoma tergeminus*, Say. Massasauga. Prairie Rattle Snake. Found in all portions of the State except "the heavily timbered regions of the South."^{*} Formerly abundant in the Northern portion, but less common at present.
3. *Ancistrodon piscivorus*, Lac.; sub-sp. *piscivorus*, Lac. Water Moccasin. Found in the Southern part of the State.
4. *Ancistrodon contortrix*, Linn. Copper-head. Cotton-mouth. Found occasionally in all parts of the State.

^{*}Fide Kennicott. List of Rep. and Batr. of Cook Co., 1853. Transactions of Illinois Agricultural Society.

COLUBRIDÆ.

5. *Carphophiops helenæ*, Kenn. Helen Tennison's Snake. From Southern Illinois.
6. *Carphophiops amœnus*, Say. Ground Snake. Found throughout the State, but not abundant.
7. *Carphophiops vermis*, Kenn. Worm Snake. From the Southern portion.
8. *Virginia valeriæ*, B. & G. Valeria Blaney's Snake. Southern Illinois.
9. *Virginia elegans*, Kenn. Kennicott's Brown Snake. Southern Illinois.
10. *Haldea striatula*, Linn. Brown Snake. From the Southern portions of the State.
11. *Abastor erythrogramus*, Daud. Red-lined Snake. From Southern Illinois.
12. *Parancia abacura*, Holb. Red-bellied Horn Snake. Found in Southern Illinois.
13. *Oceola elapsoides*, Holb. Scarlet Snake. Southern Illinois.
14. *Ophibolus doliatus*, Linn; sub-sp. *coccineus*, Schl. Red King Snake. Southern Illinois.
15. *Ophibolus doliatus*, Linn; sub-sp. *doliatus*, Linn. Corn Snake. Southern part of the State.
16. *Ophibolus doliatus*, Linn; var. *triangulus*, Borè. Milk Snake or Spotted Adder. Abundant throughout the State.
17. *Ophibolus getulus*, Linn; var. *Sayi*,* Holb. King Snake. Found in all parts of the State.
18. *Ophibolus rhombomaculatus*, Holb. Southern Illinois.
19. *Ophibolus calligaster*, Say. Kennicott's Chain Snake. Southern part of State.
20. *Diadophis punctatus*, Linn; sub-sp. *punctatus*, Linn. Ring-necked Snake. Throughout the State. Not common.
21. *Diadophis punctatus*, Linn; sub-sp. *amabilis*, B. & G. Southern Illinois.
22. *Diadophis arnyi*, Kenn. Arny's Ring-necked Snake. Southern Illinois.
23. *Cyclophis vernalis*, De K. Green or Grass Snake. Abundant in the Northern part of the State; rare in the Southern.
24. *Cyclophis æstivus*, Linn. Summer Green Snake. From Southern Illinois.
25. *Coleber emoryi*, B. & G. Emory's Racer. Found in the Southern portion of the State.
26. *Coleber lindheimeri*, B. & G. Southern Illinois.

*This species has been taken in Wisconsin by Dr. P. R. Hoy, of Racine.

27. *Coluber vulpinus*, B. & G. Fox Snake. Common in Northern Illinois; probably found throughout the State.
28. *Coluber obsoletus*, Say; sub-sp. *obsoletus*, Say. Pilot Snake. Throughout the State.
29. *Coluber obsoletus*, Say; sub-sp. *confinis*, B. & G. Racer. Southern Illinois.
30. *Coluber guttatus*, Linn. In the Smithsonian collection there is a specimen from Mt. Carmel, Ill.
31. *Ptyophis sayi*, Schl.; sub-sp. *sayi*, Schl. Western Pine Snake. Found throughout the State. Not common.
32. *Bascanion constrictor*, Linn; sub-sp. *constrictor*, Linn. Black Snake. Blue Racer. Abundant throughout the State.
33. *Eutænia saurita*, Linn. Riband Snake. Swift Garter Snake. Throughout the State.
34. *Eutænia faireyi*, B. & G. Fairies' Garter Snake. Occurs throughout the State.
35. *Eutænia proxima*, Say. Say's Garter Snake. Found in all parts of the State; common in the Northern portion.
36. *Eutænia radix*, B. & G. Hoy's Garter Snake. Very abundant in the Northern part of the State.
37. *Eutænia vagrans*, B. & G.; sub-sp. *vagrans*, B. & G. Spotted Riband Snake. A typical specimen of this species was collected near Chicago by Mr. E. W. Nelson in 1874.
38. *Eutænia sirtalis*, Linn; sub-sp. *dorsalis*, B. & G. Common Striped Snake. Abundant in all parts of the State.
39. *Eutænia sirtalis*, Linn; sub-sp. *sirtalis*, Linn. Common Garter Snake. Exceedingly common throughout the State.
40. *Eutænia sirtalis*, Linn; sub-sp. *parietalis*, Say. Red-spotted Garter Snake. "Occurs plentifully in the Wabash Valley."* Has also been taken in the central portion of the State.
41. *Eutænia sirtalis*, Linn; sub-sp. *obscura*, Cope. Common in Northern Illinois.
42. *Storeria occipitomaculata*, Storer. Red-bellied Snake. Common in all parts of the State.
43. *Storeria dekayi*, Holb. De Kay's Brown Snake. Found throughout the State; abundant in the Northern portion.
44. *Tropidoclonium kirtlandi*, Kenn. Cora Kennicott's Snake. Rare in Northern Illinois; abundant in central.
45. *Tropidonotus grahami*, B. & G. Graham's Snake. Found throughout the State; less abundant than formerly in the Northern portion.
46. *Tropidonotus leberis*, Linn. Leather Snake. Occurs throughout the State; abundant in the Northern portion.

*Fide R. Ridgeway.

47. *Tropidonotus fasciatus*, Linn. Fasciated Water Snake. Southern Illinois.
48. *Tropidonotus sipedon*, Linn; sub-sp. *sipedon*, Linn. Water Snake. Abundant in all parts of the State.
49. *Tropidonotus sipedon*, Linn; sub-sp. *woodhousei*, B. & G. Found throughout the State.
50. *Tropidonotus sipedon*, Linn; sub-sp. *erythrogaster*, Sh. Red-bellied Water Snake. Found throughout the State.
51. *Tropidonotus rhombifer*, Hall. Throughout the State.
52. *Tropidonotus cyclopium*, D. & B. Southern Illinois.
53. *Heterodon platyrhinus*, Latr. Spreading Adder. Abundant in all parts of the State.
54. *Heterodon simus*, Linn; sub-sp. *simus*, Linn. Hog-nosed Snake. Occurs throughout the State.*

LACERTILIA.

SCINCIDÆ.

1. *Oligosoma laterale*, Say. Ground Lizard. Southern Illinois.
2. *Eumeces fasciatus*, Linn. Blue-tailed Lizard. Found throughout the State; especially common in the Southern portion.
3. *Eumeces obsoletus*, B. & G. Central and Southern Illinois.

TEIDÆ.

4. *Cnemidophorus sexlineatus*, Linn. Six-lined Lizard. Found in all parts of the State, and extends Northward into Wisconsin.†

ANGUIDÆ.

5. *Opheosaurus ventralis*, Daud. Glass Snake. Found throughout the State. Abundant in the central part; formerly common in the Northern, but rare at present. Has been taken in Southern Wisconsin.‡

IGUANIDÆ.

6. *Sceloporus undulatus*, Harl.; sub-sp. *undulatus*, Harl. Swift Lizard. Taken throughout the State; abundant in some localities.

* Dr. P. R. Hoy has taken this species in Western Wisconsin.

† Wisconsin. Fide Dr. P. R. Hoy.

‡ Wisconsin. Fide Dr. P. R. Hoy.

TESTUDINATA.

TRIONYCHIDÆ.

1. *Amyda mutica*, Les. Leathery Turtle. Found in the Mississippi and other rivers of the State. Has been taken in Lake Michigan.
2. *Aspilonectes spinifer*, Les. Common Soft-shelled Turtle. Found in Lake Michigan; abundant in many of the rivers of the State.

CHELYDRIDÆ.

3. *Chelydra serpentina*, Linn. Common Snapping Turtle. Very common in all localities.
4. *Macrochelys lacertina*, Schw. Alligator, or Mississippi Snapper. Southern Illinois. Has been taken in the Mississippi as far North as Wisconsin.*

CINOSTERNIDÆ.

5. *Aromochelys odoratus*, Latr. Musk Turtle. Stink Pot. Throughout the State.
6. *Aromochelys carinatus*, Gray. Has been taken as far north as Lake County.

EMYDIDÆ.

7. *Pseudemys hieroglyphica*, Holb. Southern Illinois.
8. *Pseudemys troosti*, Holb. Yellow-bellied Terrapin. Southern part of the State.
9. *Pseudemys elegans*, Wied. Southern Illinois.
10. *Malacoclemmys geographicus*, Les. Map Turtle. Found throughout the State.
11. *Malacoclemmys pseudo-geographicus*, Holb. Le Sueur's Map Turtle. Found in all parts of the State.
12. *Chrysemys picta*, Herm. Painted Turtle. Found throughout the State; abundant in the Northern portion.
13. *Emys meleagris*, Shaw. Blanding's Turtle. Abundant in Northern Illinois.
14. *Cistudo clausa*, Gm. Common Box Turtle. Throughout the State.

*Wisconsin. Fide Dr. P. R. Hoy.

Vol. I.

No. IV.

BULLETIN

OF THE

CHICAGO ACADEMY OF SCIENCES.

REPORT OF THE COMMITTEE ON THE

MICROSCOPIC ORGANISMS IN THE BOWLDER
CLAYS OF CHICAGO AND VICINITY.

H. A. JOHNSON, M. D.,
B. W. THOMAS, F. R. M. S., } *Committee.*

CHICAGO:

JOHN MORRIS, SUCCESSOR TO CULVER, PAGE, HOYNE & CO., PRINTERS,
1884.





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H. A. JOHNSON, M. D., B. W. THOMAS, F. R. M. S., Committee.

At the regular monthly meeting of the Chicago Academy of Sciences, held Tuesday evening, January 15, 1884, the following paper was submitted by the special committee to which had been assigned the task of investigating the "boulder clays" underlying this city:

While the lake tunnel, for the purpose of supplying the city of Chicago with water from Lake Michigan, was in process of construction, specimens of the clay through which the excavation was made were subjected to microscopical examination by several members of the Academy, for the purpose of determining the presence or absence of organic remains. This was during the years 1865 to 1867. The result of these examinations was the discovery by the members of the present committee and others of a disc, varying from $\frac{1}{85}$ part of an inch to $\frac{1}{250}$ of an inch in diameter. They were yellow in color, apparently flat or concavo-concave, and were unknown to any paleontologist to whom they were submitted. On the completion of the lake tunnel, large numbers of the same discs were frequently observed in the precipitate from the city water supply. Slides were sent to New York and to London, but without obtaining any information on the matter. The subject was then allowed to rest, and nothing further was done toward ascertaining their character, distribution, or affinities till the last summer, when an examination of clays collected by an exploring party of the Academy from the high bluffs on the shore of Lake Michigan, twenty miles north of this city, revealed the presence of discs identical in character with those found in the tunnel clays and in the precipitate from the lake water. As a result of this discovery, the present committee was formed and instructed to more thoroughly investigate the microscopic organisms of our boulder clay.

In the performance of this duty, the committee have examined many specimens of clay and their contents of fragments of shale, etc., from this vicinity, and also of clay and shale from the Carboniferous deposits of Illinois and other States. Slides from these clays and shales, as well as from our own deposits, and from our city water supply, have been prepared and are under the microscopes for examination at the close of the paper.

The committee have some additional information in regard to these discs, but before entering upon the results of their own study, they beg to call the attention of the Academy to the literature of the subject, for, since 1867, there has been created a literature.

In 1871, Prof. J. W. Dawson, of Montreal, described a form found in the shales at Kettle Point, Lake Huron, known as the Erian formation, and which has been referred to the Marcellus shales of New York. The descriptions of Prof. Dawson apply fairly well to the bodies found here and first noticed in 1865-66-67. They are evidently the same or belong to the same family. Since Dr. Dawson's article these bodies have been found in widely distant localities, but always in shales of the upper Devonian age, or in close relation to them, the only exception being, so far as known to the committee, the clays of Chicago and vicinity. With the same exception they have always been found *in situ*—that is, in deposits which have not been transported or disturbed. These microscopic forms, found in abundance in our boulder clay and in the city water supply, testify to the former existence of the oil-bearing shales in areas from which denudation has now entirely removed them.

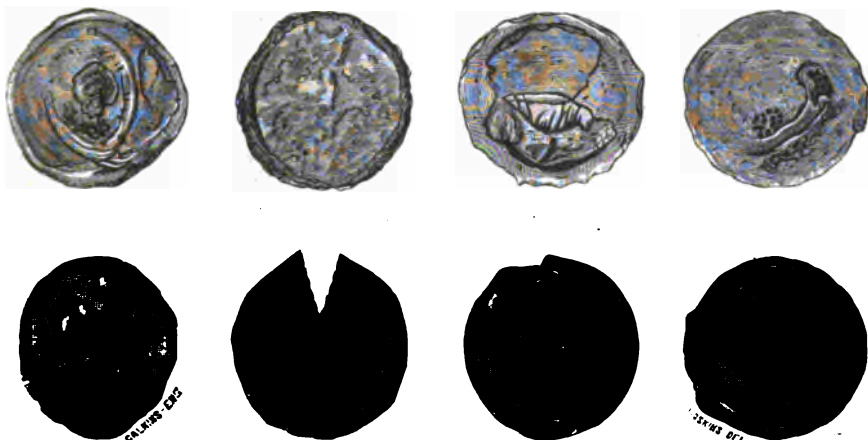
Prof. Dawson described these discs as brownish in color, in his paper published in 1871. He considered them as spore cases or *Macrospores* of some *Acrogenous* plant. This paper was published in the *American Journal of Science* for April, 1871. They are there described as "flattened, disc-like bodies, slightly papillate externally, and with a minute point of attachment at one side and sometimes with a slit more or less gaping at the other. Viewed under the microscope as transparent objects, they appear yellow, like amber, and show little structure except that the walls can be distinguished from the internal cavity, and the latter is seen in places to contain patches of granular or flocculent matter."

The shale in which these discs were found contained bituminous matter and burned with much flame. There were also other small particles which Prof. Dawson believed to be stems of a species of *Calamites*. The description of these stems may be accepted as applying to similar particles found adhering to or associated with the discs as noticed by us in 1865-67, and since. What these discs are seems to be yet a question. Prof. Dawson appears to have given no further attention to the subject till 1882, when Prof. Edward Orton, of Columbus, Ohio, reported the discovery of similar bodies in the Erian and lower Carboniferous shales of Ohio. Prof. Orton published his discovery in the transactions of the *American Association for the Advance-*

ment of Sciences for that year. At the same meeting of the association, in the discussion of Prof. Orton's paper, Prof. Williams, of Cornell University, mentioned that he had found similar bodies in the Hamilton shales of New York, and that they were associated with a curiously pinnated plant, a species of *Ptilophyton*.

Prof. J. M. Clarke, of Northampton, Mass., subsequently reported the presence of similar bodies in the Genesee shales, and also from the Carboniferous limestones. All these reports, however, did not enable Prof. Dawson to definitely assign to this form its proper place in the flora of this early age. In March, 1883, Mr. Orville Derby, of the geological survey of Brazil, sent Prof. Dawson specimens from the Erian formation of that country, and which contained forms similar to those which had previously been discovered in North America. It appears that the late Prof. Hart had previously reported specimens which were by him assigned to the Carboniferous age, but which Prof. Dawson was inclined to think must belong to the upper Devonian. Prof. Dawson has given provisionally to the South American varieties the name of *Sporangites Braziliensis*, and to the North American forms the name of *Sporangites Bilobatus*, or *Huronensis*, and associates them both with the Acrogenous plants of the Devonian formation.

Prof. Orton's paper, in the transaction of the American Association, discusses in more detail the conditions under which these forms are found in Ohio. They are distributed throughout the upper Devonian formations and through the immense thickness of these deposits, in some places not less than 1000 feet. They do not, however, present the same characteristics in every horizon of this formation. They vary in size and in other respects, which leads Prof. Orton to think there are grounds for separating them into several species. What these differences are except size he does not state. His description may in the main be taken for the discs found in our own clays.



MACROSPORES FROM THE CHICAGO TUNNEL CLAYS AND CITY WATER-SUPPLY.

We have, however, none so large as those discovered by Prof. Orton. Our largest forms are not more than $\frac{1}{8}$ of an inch in diameter, and our smallest about $\frac{1}{16}$ of an inch. We have two and possibly more varieties. One has a well-marked ledge or zone around it, and extending perhaps one-eighth of the way across it. Within this are the spines noted below. Others have no such markings, and do not as a rule have spines, and while some are in color a very light yellow or amber, and almost transparent, others are of a dark reddish brown and almost opaque. Whether these differences are sufficient to justify their separation into different species, seems to be at present doubtful. So far no forms have been met with by either of us having anything like a stem or point of attachment. Nor have we found any of the spherical or oval sacs which were contained in the collections of Mr. Derby.

There are found here, however, what we believe have not been found elsewhere—namely, on many of the discs, are well-marked *spines*. These spines, as a rule, occupy a central portion, the diameter of which is about three-fourths of the entire breadth of the disc, but in some instances they cover the entire surface. Along with these discs are, in quite large quantities, broken pieces of what seem to have been leaves; perhaps pinnate in form. In addition to these forms, dark globular masses, which seem to be, possibly, spores or microspores, are frequently seen on the discs, and also scattered among them, and are—at least, in some cases—also contained within the substance of the discs. They are regular in form, and vary in size from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in diameter. They are evidently organized, for in some cases there is seen a reticulum or net-work within the dark substance of the body. With these microspores, if such they are, are also masses of dark matter that, at least in some cases, are made up either of these globular forms alone, or of these and other organic material, such as the stems described by both Prof. Dawson and Prof. Orton. The clay beneath the city of Chicago and in the vicinity is full of boulders of various sizes, from that of a walnut, up to several cubic yards, and on many of these boulders are well-defined ice markings. Some of the smaller boulders are shale, which has never been ground down, and in these unchanged pieces we also find frequently large numbers of discs. These masses of shale, so far as we can ascertain, are identical with the shales of the upper Devonian formation, and, like the black shales of Ohio, burn with a clear, bright flame, giving out a strong petroleum odor.

It will be seen that the discs are evidently not the product of their present location. They have been in some far-off age imbedded in the shales, and subsequently these shale deposits have been broken up and most of it ground to clay, and with other material constituting the "Boulder Clays" have been redeposited beneath the lake and the adjacent shores. They are now undergoing another dispersion, for they are being washed from their present position in the Chicago clays and are mixed with the sands and alluvium to be carried by the currents and winds to some new resting place. Conse-

quently our water-supply is now full of these products of probably some millions of years ago. And with the aid of the Microscope, they now testify that in some remote period of time, and amid very different surroundings, an abundant marine vegetation was being produced which has been preserved to our own day. On the tables are Microscopes and slides which illustrate how abundantly they exist in the clays of our "boulder drift," in the Black Shales of Ohio, and in the water from our hydrants.

Prof. Orton has called attention to the great quantities of resinous matter contained in these shales. If a piece containing these discs is held in the flame of a spirit lamp, the discs burn like resin, and leave the pit or mold in the rock which they have occupied distinctly marked. In some localities, these shales have been distilled, and one ton of the black Ohio shales has been made to yield twenty gallons of oil. This has been done as a business, and we understand has been made to pay.

Prof. Orton suggests that these bodies are in part at least the origin of the petroleum found so abundantly in or near the horizon of the Devonian formations in Pennsylvania and other localities constituting the oil regions.

It seems not improbable that this hypothesis is correct. These plants must have been very abundant through a wide extent of territory and continuing through a long period of time. The study of their distribution is not yet complete, but the Committee beg to call attention to the fact that these organisms were, so far as known, first discovered here in the tunnel clays, and secondly they have never been found elsewhere except *in situ*.

NOTE BY B. W. THOMAS.

Since the reading of the report of your Committee on the "Microscopical Organisms found by them in the Boulder Clays underlying Chicago and vicinity," at the January meeting of the Academy, in the absence from the city of Dr. Johnson, I have individually continued the examination of drift material in this vicinity and from other parts of the Northwest.

So far as examined, all of the clays on the west shore of Lake Michigan, from Kenosha, Wis., on the north, to the Indiana State line on the south, contain an abundance of the *Macrospores* referred to in that paper, both free in the clay and *in situ* in fragments of shale. These clays range from some seventy feet above the level of Lake Michigan to (I am advised) over 200 feet below its surface.

In the examination of clays from other localities, I get some very unexpected results. In several specimens of "Blue Boulder Clay" kindly sent by Prof. N. H. Winchell, State Geologist of Minnesota, as "taken from fourteen to twenty-one feet below the surface when digging a well at Litchfield, Meeker County, Central Minnesota," I find an abundance and several species, of fossil *Rhizopods*, fragments of *Diatoms*, several species of well-

ul
 preserved and characteristic *Foraminifera*, among others *Textularia globosa*, ul
Rotalia globosa and *Globigerina*, as identified by Prof. Joseph Leidy, who
 advises me that these forms are yet living and common in the Atlantic Ocean.
 A disc form with crenate margin, resembling the lorica of an infusorian, is
 quite abundant, and large quantities of forms and fragments not yet identi-
 fied. From the great similarity of some of the contents of the Minnesota
 clays with what we find associated with the macrospores in the Chicago
 clays, I am quite confident that we shall yet find in the Minnesota clays,
 mingled with *Rhisopods*, etc., of the *Cretaceous* formation, the shale an macro-
 spores of the *Devonian*.

All of the forms yet identified, both in the Chicago clays and in those from Minnesota, are undoubtedly of marine origin.

In a specimen of clay from the lower drift deposit, 135 feet below the surface, kindly sent to me from Bloomington, Ill., by Dr. G. W. Mason (there are two well-defined deposits in that vicinity, separated by a stratum of black soil and quantities of well preserved timber, with stumps of trees apparently in their natural position), I find discs similar in every way to the macrospores found here, except that they are smaller in size.

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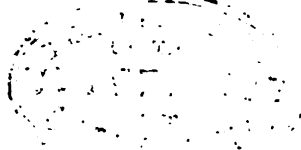
BULLETIN

—OF THE—

CHICAGO ACADEMY OF SCIENCES.

A PAPER ON

The Northern Pitcher-Plant or the Side-saddle Flower,
Sarracenia purpurea, L.



By W. K. HIGLEY.

LAKE GENEVA, WIS.,
JAMES E. HEG, PRINTER.
1885.





BULLETIN

—OF THE—

CHICAGO ACADEMY OF SCIENCES.

The Northern Pitcher Plant or the Side-saddle Flower, *Sarracenia purpurea*, L.

By W. K. HIGLEY, Seminary, Lake Geneva, Wisconsin.

That insects are of great use in the vegetable economy is a subject of much interest to many scientific minds of the present day, causing many investigations resulting in experiments that are leading us into a deeper and truer knowledge of the physiology of plants.

These investigations are transforming many theories into facts; many mere fancies into realities; many of the so-called "freaks of nature," of the older writers, into useful adaptations for aiding in the development of the plant. It is now obvious, even to the slack and unscientific observer of nature's laws and methods of work, that the insect world is necessary for the proper growth and propagation of many species belonging to the vegetable kingdom.

It is well known to the intelligent agriculturist that many of the plants used in our economy could not even mature their seeds unless aided by insects, notably the hive bees. The beautiful orchid family is a grand illustration of the usefulness of insects in fertilization. Dr. Charles Darwin has shown that each part of the flower is adapted to this end. It seems as if, in this family, nature truly abhors self-fertilization and in some species, though giving the plant all the parts of a hermaphrodite, yet arranging them so that only an insect can bring about the proper relations for propagation. Our melon, pumpkin, squash, cucumber and gourd plants are also worthy of note in this connection. "The flowers" of these "are each furnished with a long or rather deep corolla and the plants often lie flat on the ground where the leaves cover the flowers from the action of the wind. Bees and other insects are the necessary agents in crossing the flowers", for they are either diœcious or monœcious, "and to them we are indebted as one of the links in the chain which affords all our gourd-like fruits."

To this division of Entomophilous species belongs the plant under consideration in this paper. All the species of the genus *Sarracenia* are constructed in such a manner that in fertilization they are absolutely helpless without the aid

of insects. The large umbrella-like expansion of the style, which is stigmatic at the termination of the fire rays, completely hides the stamens which are decidedly below it and shielded from the wind.

A still more peculiar use of insects to the vegetable world is that of a food and many plants are specially fitted for catching and using the material of their bodies for nourishment.

Perhaps the most striking of all these plants are the pitcher-plants, some of which throw out a honeyed secretion which, trickling down the wing of the pitcher, forms a baited pathway to attract the unwary insect to the inside of the pitcher.

The genus *Sarracenia*, to which the plant under consideration belongs, is one of the three genera of the order *Sarraceniaceæ*. The species of all the genera are natives of America and chiefly of the United States, the genus *Heliamphora* being a native of Venezuela. Mr. Sereno Watson * makes the following enumeration of the species of the other two genera, *Darlingtonia* and *Sarracenia*:

Darlingtonia Californica, Torr.

Sarracenia Drummondii.

" *flava*, L.

" *psittacina*, Mx.

" *purpurea*, L.

" *nigra*, Walt.

" *Sweetii*, D C.

" *undulata*, Denie.

" *variolaris*, Mx.

All the species have root-leaves and excepting the genus *Heliamphora*, have terminal scapes bearing a single flower. The exception has a scape bearing a few flowered raceme. The leaves are all hollow and more or less pitcher-shaped, with a hood at the upper part and a wing, that is often very broad, upon one side.

As to their position in classification, this family† quite closely resembles the poppy family (*Papaveraceæ*), on the one hand, and the water-lily family (*Nymphæaceæ*) on the other. It is related to the former by the character of its petals, numerous stamens and seeds, capsular fruit, copious albumen, etc. It is connected with the latter by nearly the same characters,‡ and also by having all the leaves from the root, a one-flowered scape and more or less aquatic habits. The poppy family differs in habits, juices, in having but two or three sepals and a one-celled ovary. The water-lily family differs in having, usually, numerous petals, in the attachment of the seeds and the sessile stigmas.

By certain analogies the pitcher-plants are closely related to the sundew family (*Droseraceæ*), and the Asiatic pitcher-plant family (*Nepenthaceæ*).

A microscopical study of the minute structure of the families mentioned not only confirms the close relationship existing between them but also adds new facts to those that appear from a study merely of the external characters of their representative species §

*Bibliographical Index to North America Botany, by Sereno Watson, Smithsonian Miscellaneous collections.

†General System of Botany, LeMaout, and Decaisne. p. 212.

‡The water-lily family in some of its forms has a definite number of stamens.

§Since the writing of this paper Mr. J. F. James has published a very interesting article on "How the Pitcher Plant got its Leaves." (*American Naturalist* Vol. xiv, p. 567.)

After tracing the apparent gradation of adaptability for taking insect food existing between the species of the genera of *Sarraceniaceæ* from the less marked trap and imperfect

Our northern pitcher-plant is, perhaps, the one of greatest interest to the people of the Northern States.

It is by far the most common form of the genus extending in its range over the states east of the Mississippi and north from Florida far into the British Possessions. It is not so elaborate an insect catcher as some of the more southern forms which have already been spoken of as throwing out a honeyed lure which attracts numerous ants, an insect rarely found in our species.

The pitcher leaves (*Ascidia*) of the Side-saddle flower, as well as those of all the family, are evidently phyllodia. They have the parallel veination of petioles acting as blades and the edge is invariably turned toward the sky. The hood may represent the blade of the leaf. The wing forms the greater part of the young leaf.

Inside these pitchers are found hairs, which cover more or less of the inner surface. Those which cover the hood continue to or a little beyond the junction with the tube. Following this area is a smooth surface which extends to near the point where the leaf begins to contract when a patch of less stiff hairs are met with. This time they extend into the narrower portion of the tube. All the hairs point downward.

The position and form of these hairs, especially those on the hood and upper part of the tube and in fact any that may be above the fluid, in the lower part of the leaf, would show that their function, in part at least, is to prevent the escape of any insect that may have entered the tube. The hairs in the lower part of the tube probably act, to some extent, as absorbents of the nitrogenous matter decaying within the leaf. Some acute observers claim that at the end of each hair there is a minute opening, thus allowing the nitrogenous fluid to pass directly into the apical cell of the hair. This does not seem to be the case but instead the wall surrounding the entire cell is very thin. These hairs are simple trichomes, that is they are rather cells than organs. Unlike the tentacles of the sundew, in no case do the spiral bundles enter their tissue. I am inclined to believe that these cellular hairs serve more than one purpose in the economy of the plant.

A study of the structure and physiology of the whole family shows that all the forms need a great deal of absorbing surface for there seems to be a lack of stomata. The tissue of the leaf is almost constantly gorged with a large supply of nourishment consisting, evidently, of absorbed nitrogenous matter, and

pitcher of *Hellampora* through the genus *Sarracenia* to the remarkable trap pitcher of *Darlingtonia* with its attractive appendages, digestive fluid and sweet lure, Mr. James says: "scarcely any of the steps showing the progress are needed to complete the line of development. It can be traced directly from *Hellampora* to *Darlingtonia*, and it is only necessary to have an ancestral form from which to start to have a complete pedigree. It seems probable that the water-lily family and the pitcher-plant family had a single ancestor in common. This ancestor was aquatic, or least an inhabitant of swampy places. It had small, probably peltate, perhaps reniform leaves, and these had hollow petioles. The inner space was lined with hairs as are now the inner surfaces of the stems of *Nymphaea* and its allies; it had a four or five parted flower, with many stamens and a broad stigma. From such an ancestor came two or three branches. One of these developed into plants having an aquatic habit, large leaves and long petioles, and peduncles like those which are found at present in the water-lilies. The other branch diverged to form plants living in boggy or swampy grounds, with pitcher-like leaves whose insectivorous proclivities were developed later on."

Mr. Jain's suggests that these proclivities were developed by a true process of natural selection. The more or less saucer-like peltate leaves may possibly have held some water in which insects were drowned. This fluid, by standing causing the decay of the blade at the insertion of the petiole, found its way into the hollow petiole and finally by absorption of the nitrogenous matter the plants gained nourishment that could be used in its growth. This is a adaptation being of use to the plant might lead, in the next generation, to leaves better fitted for taking food in this manner. This in course of time would give rise to a generation of petioles peculiarly adapted to catching water and insects by being pitcher-like in form. The blade no longer needd for absorption would become a mere rudiment and then would follow the further process of perfecting traced by Mr. James in *Sarraceniaceae*.

needs a great extent of surface exposed to the air for the purpose of absorption in carrying on the functions of assimilation and metastasis. In support of this there is considerable evidence, the most important of which is the fact that many of these hairs, especially those on the hood, contain chlorophyll. From a study of marked leaves through the whole season I am led to believe that some of the hairs are absorbed as the leaf grows old. This would indicate that as the function of the leaf are lessened the extent of absorbing surface is reduced.

When the leaf has apparently nearly stopped absorbing the moisture from the tube it may still be an active insect trap. At this time an especially strong odor is given off from the decaying mass of insects. It would seem that the insects caught now could be of no use except as a fertilizer, when by the decay of the leaves, all this mass of decomposing nitrogenous matter is deposited around the roots of the plant. The decaying material, moreover, seems to hasten the decay of the leaf, as its vitality is lessened by the advancing season.

It is noticeable that there are many insects around the leaves just at twilight or when the sky is overcast with heavy clouds. Remains of nocturnal insects are also very common in the macerating mass. This seems to indicate that flies and other insects seek the hollow leaves in which to retreat during the hours when they are naturally at rest. It is a fact that insects seek retreats of this kind.

True to the habits of the spiders to seek those places for their homes that flies frequent, there is one that makes its home at the top of the leaves spinning its web so that it nearly covers the whole opening. In each case that I have observed it is the same species but whether it always seeks the pitchers, I cannot state.

An insect lighting upon the leaf starts immediately to walk toward the inside. It seldom stops till the smooth place is reached where sooner or later it loses its foot-hold and falls. In some cases they try to fly upward from the bottom of the pitchers. In but one case have I seen an insect escape in this manner. This, a beetle, obtained its freedom by flying from one side of the tube to the other till the opening was reached.

A slight secretion has been observed by many near the opening of the pitcher. This seemingly has but little power to attract insects, though at times it is quite copious.

Mr. Joseph Jackson says,* "While collecting a few specimens of *S. purpurea*, L., I was surprised on drawing aside the petals to look at the stamens to see the whole cavity formed by the petals and the peltate expansion of the style filled with flies as large as the common house fly, all busy as could be eating the pollen, of which scarcely a grain could be seen. I counted fourteen flies in one flower. They were in no hurry to vacate the premises. There was a shower coming up at the time, but they were evidently there for food. Nearly every plant examined was filled in the same way."

Mr. J. F. James suggests† that perhaps "there is something in the pollen, or in some secretion of the flower which has the effect of stupefying or intoxicating the insect and that then they might easily be shaken from the flower, by the wind, into the open mouths of the rosette of leaves below."

My observations differ somewhat as to the usefulness of these insect visits to the flowers. There are two or three species of *Diptera* found in the manner described. They are evidently attracted to the flower by some property of the

*Bot. Gazette Vol. vi. No. 7.

†Amer. Nat. Vol. xvii, p. 284.

pollen or a secretion of some other part of the flower, but it would seem mainly for the purpose of aiding in fertilization for a lense reveals the fact that pollen is quite freely scattered over their backs. Moreover these plants flower during the latter part of May and first of June, while insects are caught during the months of May, June, July and August. Though without question some of the flies from the flowers do eventually find their way into the pitchers underneath, yet these species are not nearly so common in the decomposing mass as some other species. Some time was spent in taking notes as to the effects of this food upon the flies but without any results showing stupefaction.

The great question is: What purpose do the decaying remains in the bottom of the tube serve in the economy of the plant? In order to decide this question it will be necessary to know the chemical nature of the fluid found in the pitchers. Several chemical analyses were made under as widely different conditions as a limited region of country would allow. As a result of the examination of over 800 leaves I find that none contained any fluid before they had opened. These were collected from several localities. After opening there is no fluid till after the first rain except in a few cases when there has been a heavy dew.

The following table is the result of a series of twenty-five chemical analyses, selected from one hundred the total number made, and shows approximately the composition of the fluid before it contained any insects. The sediment is the result of evaporation:

Number.	Condition of the Soil.	Time in days since leaf opened.*	Color of Fluid.	Dried Residue from Evaporation†		Reaction.	INORGANIC SUBSTANCES.	REMARKS.
				Organic.	Inorganic.			
1 Swamp	5	1	Clear...	3...	2....	Slightly acid	Ammonium, †Potassium, Carbonic Acid.....	
2 Swamp	8	4	Slightly Yellow..	9...	3....	Acid....	Ammonium, Lime, Potassium, Carbonic Acid.....	Under trees in edge of swamp.
3 Swamp	15	3	Yellow..	11...	4....	Acid....	Ammonium, Potassium, Sodium, Hydrochloric, Sulphuric and Carbonic Acids.	Under trees in edge of swamp.
4 Dry	20	18	Clear...	14...	5....	Acid....	Ammonium, Potassium, Lime, Sodium, Magnesium, Carbonic, Hydrochloric, and Sulphuric Acids.	At edge of woods in soil containing much lime.
5 Moist	6	2	Clear...	6...	3....	Acid....	Ammonium, Lime, Potassium, Hydrochloric and Carbonic Acids.	Not far from the last.
6 Wet	10	4	Tinged..	8...	3....	Acid....	Ammonium, Potassium, Sodium, Sulphuric, Hydrochloric and Carbonic Acids.	
7 Wet	12	8	Tinged..	10...	4....	Acid....	Ammonium, Potassium, Lime, Aluminium, Sulphuric and Carbonic Acids.	Near dusty road and under trees.
8 Swamp	15	14	Tinged..	20...	5....	Acid....	Ammonium, Potassium, Lime, Aluminium, Iron, Sulphuric and Carbonic Acids.	In neighborhood of several iron springs, near a road and under trees.
9 Swamp	11	5	Yellow..	7...	3....	Acid....	Ammonium, Lime, Potassium, Hydrochloric and Carbonic Acids.	In deep grass.
10 Swamp	7	4	Clear...	4...	1....	Acid....	Ammonium, Lime, Potassium, Hydrochloric, and Carbonic Acids.	In deep grass.
11 Swamp	7	4	Clear...	5...	1....	Nearly neutral.	Ammonium, Lime, Potassium, Sodium, Hydrochloric, and Carbonic Acids.	Same plant as last.
12 Swamp	14	6	Dirty...	13...	4....	Slightly acid	Ammonium, Lime, Potassium, Sodium, Aluminium, Carbonic, Hydrochloric and Sulphuric Acids.	In grass near woods and dusty road.
13 Swamp	9	5	Dirty...	7...	2....	Acid....	Ammonium, Lime, Potassium, Iron, Aluminium, Sulphuric and Carbonic Acids.	In grass near woods and dusty road.
14 Swamp	10	6	Quite Clear...	4...	1....	Nearly neutral.	Ammonium, Potassium, Lime, Sodium, Hydrochloric and Carbonic Acids.	In open swamp near road.
15 Swamp	5	2	Quite Clear...	2...	1....	Nearly neutral	Ammonium, Potassium, Lime, Sodium, Hydrochloric and Carbonic Acids.	Open swamp.
16 Wet...	8	4	Yellow..	6...	3....	Slightly acid	Ammonium, Potassium, Lime, Sodium, Magnesium, Carbonic and Hydrochloric Acids.	Under grass.
17 Swamp	3	1	Clear...	2...	2....	Slightly acid	Ammonium, Potassium, Carbonic Acids.	Open swamp.
18 Dry ...	8	5	Yellow..	4...	4....	Slightly acid	Aluminium, Iron, Potassium, Sodium, Ammonium, Silica, Sulphuric, Hydrochloric and Carbonic Acids.	Side of dusty road and in the shade.

19 Dry....	2	1	Clear	4....	2....	Nearly neutral acid	Ammonium, Aluminum, Potassium, Sulphuric, Hydrochloric and Carbonic Acids.	Side of dusty road and in the shade.
20 Moist	11	5	Yellow	5....	3....	Slightly acid	Ammonium, Potassium, Lime, Iron, Hydrochloric and Carbonic Acids.	In open swamp near iron springs.
21 Moist	13	5	Yellow	7....	3....	Slightly acid	Ammonium, Potassium, Lime, Hydrochloric and Carbonic Acids.	Under trees.
22 Wet	3	1	Clear	2....	2....	Slightly acid	Ammonium, Lime, Carbonic Acid.	Open swamp.
23 Swamp	5	2	Clear	4....	2....	Slightly acid	Ammonium, Lime, Potassium, Sodium, Hydrochloric and Carbonic Acids.	Open swamp.
24 Swamp	7	2	Clear	6....	2....	Slightly acid	Ammonium, Lime, Potassium, Sodium, Hydrochloric and Carbonic Acids.	Open swamp.
25 Swamp	8	3	Clear	5....	1....	Slightly acid	Ammonium, Lime, Potassium, Sodium, Hydrochloric and Carbonic Acids.	Open swamp.

*This has reference to the time since the leaf was in such a condition that rain could easily enter it.
†...number of parts in 1000.

‡It is probable that in each case when ammonium is reported, nitric acid was combined with it (NH₄, NO₃) but there being but a trace it could not readily be found without much concentration.

§The organic residue when examined with a microscope revealed the fact that it consisted, to a great extent, of pollen, various other vegetable structures, Infusoria, algae and the like.

The following tables represent analyses made each month to test the condition of the liquid as the season advanced. The ten enumerated in each table were selected from one hundred analyses made from leaves picked the last day of the month. In each set the two extremes are given and the intermediate ones illustrated well the mean numbers of the complete series of one hundred. The amount of residue is expressed in parts per 1000:

MAY.

Number.	Condition of the soil.	Time in day's since rain had fallen.	Color of Fluid.	Dried residue from evap'rat'n		Reaction.	INORGANIC SUBSTANCES.	REMARKS.
				Organic.	Inorganic.			
1	Swamp	15	Yellow	60....	4.....		Ammonium, Potassium, Lime, Sodium, Magnesium, Carbonic and Hydrochloric Acids.	In grass and protected.
2	Quite dry	23	Wine..	100....	8.....		Ammonium, Potassium, Sodium, Aluminium, Iron, Sulphuric, Carbonic and Hydrochloric Acids.	Very near dusty road.
3	Moist.	5	Dirty..	108....	5.....		Same as No. 1.	
4	Swamp	7	Dirty..	110....	4.....		Same as No. 1.	Near edge of swamp but away from dust of roads.
5	Edg. of Swamp	5	Wine..	130....	6.....		Ammonium, Potassium, Lime, Sodium, Magnesium, Iron, Hydrochloric and Carbonic Acids.	Near sandy hill-side.
6	Swamp	3	Yellow	68....	3.....	ACID.	Ammonium, Sodium, Potassium, Lime, Hydrochloric and Carbonic Acids.	
7	Swamp	1	Dark..	82....	2.....		Same as No. 6.	Protected by deep grass.
8	Edg. of swamp	6	Dark..	110....	4.....		Ammonium, Potassium, Lime, Magnesium, Aluminium Sulphuric, Hydrochloric, Carbonic Acids.	Near dry hill-side.
9	Dry ...	6	Dirty..	105....	7.....		Same as No. 2.	Barren hill-side, clay soil.
10	Moist.	11	Wine..	115....	4.....		Same as No. 6.	Near dry, grassy hill-side and nearly under a willow bush.

JUNE.

Number.	Condition of the soil.	Time in dry's since rain had fallen.	Color of Fluid.	Dried residue from evap'rat'n		Reaction.	INORGANIC SUBSTANCES.	REMARKS.
				Organic.	Inorganic.			
1 Swamp	5	Dirty..	120...	7....			Ammonium Potassium, Lime, Sodium Magnesium, Aluminium, Sulph'ric, Hydroch'ric, Carbonic Acids.	Near road.
2 Edg. of Swamp	7	Dirty..	132...	9....			Same as No. 1, with Iron.	Near road and large iron springs.
3 Moist	2	Wine..	162...	10....			Same as No. 2.	Near iron springs.
4 Dry....	3	Dirty..	150...	9....			Same as No. 3, with Silica.	Near dusty road and sandy hill-side.
5 Dry....	1	Dirty..	142...	6....		ACID.	Same as No. 4.	Same.
6 Moist..	4	Dirty..	139...	13....			Same as No. 5.	Same.
7 Swamp	6	Dirty..	157...	8....			Same as No. 2.	Near dusty road.
8 Swamp	3	Dirty..	173...	6....			Same as No. 1.	Near road and under trees.
9 Swamp	6	Dirty..	170...	5....			Same as No. 2.	In swampy place made by iron springs.
10 Swamp	4	Dirty..	147...	6....			Same as No. 1.	

JULY.

Number.	Condition of the soil.	Time in days since rain had fallen.	Color of Fluid.	Dr'd residu from evaporation.		Reaction.	INORGANIC SUBSTANCES.	REMARKS.
				Organic.	Inorganic.			
1	Swamp.	3		137	6		Ammonium, Potassium, Sodium, Lime, Magnesium, Hydrochloric and Carbonic Acids.	Remote from road but near barren spot.
2	Swamp	5		173	8		Same as No. 1, with Iron,	Similar place, but in swamp formed by iron springs.
3	Edg. of swamp	11		195	12		Ammonium Potassium, Sodium, Lime, Magnesium, Iron, Silica, Alu'm'm, Hyd'ch'rc, Sulph'ic, Carb'ic acids	Very near dusty road and sandy hill-side.
4	Swamp	15		200	7		Same as No. 3, without Iron.	
5	Dry. ..	11		195	11		Same as No. 3.	Same as No 3,
6	Swamp	15		203	6		Same as No. 1 with Silica.	In deep swamp, but where the sand could be blown in from a barren spot.
7	Edg. of swamp	15		207	9		Same as No. 2 with Silica.	Similar position to that of No. 6.
8	Swamp	9		187	6		Same as No. 7.	
9	Swamp	8		196	7		Same as No. 3, without Silica.	Near road but in very swampy place.
10	Swamp	9		205	9		Same as No. 3.	In very swampy place, but near very dusty clay road bed and under branches from tree.

AUGUST.

Number.	Condition of the soil.	Time in a year since rain had fallen.	Color of fluid.	Dried residue from evaporation		Reaction.	INORGANIC SUBSTANCES.	REMARKS.
				Organic.	Inorganic.			
1	Dry....	10		164	18		Ammonium, Potassium Sodium Lime, Aluminium Iron, Silica, Carbonic, Sulphuric, Hydrochloric Acids.	Near road and near field of sandy soil. Large proportion of silica. Prevailing winds toward the plant from the field.
2	Dry....	5		200	14		Same as No. 1.	A similar location. A large p. c. of silica.
3	Wet....	10		225	10		Same as No. 1.	A similar location but near edge of woods.
4	Wet....	15		205	8		Same as No. 1 without Silica, Aluminium or Sulphuric Acid.	Deep swamp.
5	Swamp	20		237	13		Same as No. 1 without Silica.	Near road and under tall grass and weeds.
6	Dry....	20	DIRTY.	280	16	Acid.	Same as No. 1.	In a damp but not very swampy place surrounded by barren sand-hills. Large proportion of silica.
7	Edg. of swamp	15		257	9		Same as No. 1 without Aluminium, Silica or Sulphuric Acid.	In deep swamp.
8	Moist.	5		245	12		Same as No. 1 without Silica.	Not near road but under trees.
9	Moist.	5		198	10		Same as No. 8.	In a tamarack swamp and under grass which held much dust.
10	Swamp	10		242	9		Same as No. 8.	

The oldest leaves to be found were in each case selected and it is thought that in all cases they were the growth of the season up to date. In preparation the leaf was cut open and the contents removed to a crucible, but in no case was the mass used unless of such a consistency that it would flow easily. The reaction was acid in each case but the degree of acidity increased each month and was very marked through July and August. To just what acid, if any particular one, the reaction was due in the liquid of the earlier pitchers is not certain, but in the two last months both Malic and Citric acids appeared, the former in greater abundance.

The analysis of the ash and the residue of the filtered and evaporated fluid was qualitative. The object being simply to see if there was any relation existing between the inorganic matter contained in the fluid and the surrounding soil, etc., it was not minute. In each case, where it was possible, the soil near by at all liable to get into the pitcher was analyzed. However, not all the inorganic salts could be accounted for as from the soil. Whenever it was evident that the inorganic matter was similar to the soil near the plant it is indicated in the tables under the head "remarks" by giving the character of the surrounding soil.

It seems highly probable that the first lot of insects merely decay after maceration in the water first collected in the pitchers and that this mass acts not only as a stimulant to further decay but also to render the liquid more capable of absorbing certain organic principles from the leaf, such as Malic acid, which aid in the preparation of the abundant supply of food for absorption by the leaf. Thus the first mass might be called a digestive excitant. There being no glands, the process of exciting the leaf to the secretion of an acid would be quite slow.

That this is the case, I feel assured by the fact that absorption evidently takes place much more rapidly during the last days of June and the months of July and August. It is then that much nutriment is needed and the cells are filled with matter. The large tubular cells in the structure of the lower part of the pitcher walls and in fact those extended downward into the root are at this time charged with matter, while earlier they are comparatively empty, though much nitrogenous matter has been in the leaves for several weeks.

By a set of experiments it was easily shown that the ammonia contained in the liquid, either having its source in the rain water brought to the plant, in the results of the decomposing remains of the insects, or in the absorption from the atmosphere was readily and quite rapidly absorbed by the leaf.

In these experiments it was assumed that but little would be absorbed by the liquid from the air, during the season of experiment, especially if it was a dry time. Such a time was therefore selected and the leaves so turned and propped that no rain could fall into them. The leaves marked were those that contained but few insect remains. Two in each case were examined from each plant. Great care was used that both should have the same age, amount of liquid and nearly the same amount of remains and especially that they should have as near the same size as possible.

One leaf was marked and treated as above while the fluid of the other was immediately tested for organic ammonia and the amount estimated. At the end of a week the marked leaves were picked, quickly examined and the fluid analyzed for organic ammonia. The fluid showed a decided decrease in each case, from the amount found in the one used in comparison. Though these analyses were perhaps quite far from sure in every detail yet the average difference on

comparison, viz: sixty parts in one hundred, would indicate quite rapid absorption, for such an amount could not possibly be removed in any other way.

Associated with the remains of insects in these pitchers and apparently nearly always able to overcome the obstacles to escape, are a few other insects.

The first of these a moth *Xanthoptera semicrocea*, Guen. which feeds upon the tissue of the leaves themselves, is not so common in the leaf of the side-saddle flower as in the more southern species.

There is another moth besides this which is more common. Though I have not been able to study it to any extent, yet from a casual observation I feel convinced that it is not the same species as the above though the larvæ of both are very much alike. It is possible that it may be a new variety.

The egg is lain within the tube, generally about the middle of the leaf, and fastened to the smooth surface by a web so that seemingly the egg might not only be secure but that also the larvæ might have a secure scaffolding upon which to stand as soon as hatched when it immediately covers the smooth surface with the same kind of web and is thus able to go wherever it wills. It is often the habit of this insect to close the mouth of the pitcher in the southern forms. In a few cases I found threads stretched across the opening of the hood but it is impossible to close the lips of the northern pitcher plant. "As the larvæ increases in size it frets the leaf within feeding on the parenchyma and leaving only the epidermis." Occasionally these larvæ are found dead in the bottom of the pitcher. They had apparently fallen into the liquid and drowned.

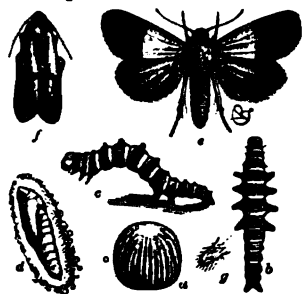
Another very common insect, even more common than the moth, is a fly, *Sarcophaga sarraceniae*, Riley. A dozen or more living larvæ are dropped into the tube by the fly where they feed upon the decaying mass of insect remains.

As a rule but one larva matures, the others having been devoured by it.

The larva undergoes its metamorphosis in the ground at the base of the leaf. Its transformation is completed in about a week.

Dr. C. V. Riley, U. S. Entomologist, has kindly furnished me with very full descriptions and cuts of the moth, *X semicrocea*, Guen. and the fly *S. sarraceniae* Riley.

These, with his permission, I append in full * for there are but few printed descriptions.



XANTHOPTERA SEMICROCEA—a, egg, enlarged; the natural size indicated at side; b c, larva, back and side view; d, chrysalis; e, normal form, with wings expanded; f, pale variety, with wings closed; g, enlarged tubercle of larva

XANTHOPTERA SEMICROCEA Guen. Egg—Globular, slightly flattened at top and bottom; 0.02 inch in diameter. Color, when mature, grayish, with about 35 ribs of a paler color, some of them anastomosing and all becoming fainter toward the crown, which is smooth.

Larva.—Average length 0.8 inch. Thickest in the middle of the body, and having but three pairs of prolegs. Color deep crimson, or lake-red, the joints being deeply separated, and their borders, especially posteriorly, being white and strongly contrasting with the red. On each of joints 4, 5, 6 and 7 is a pair of more or less confluent, velvety-black, dorsal patches, and a subdorsal, fleshy tubercle, the foremost a little the longest, the others gradually diminishing in length. The other joints are each ornamented with about a dozen small, dark, conical tubercles, transversely arranged on 2 and 3, from a trapezoid to a square on 8, 9, 10 and 11, and on 12 in an opposite position to those on 9; on the cervical shield there are two rows and on the anal plate they are all brought close together. The red parts are more or less thickly beset with short, fuzzy, dark hairs which are especially dense on the velvety patches and large tubercles mentioned. Venter from joint 8 to anus pale. Head yellowish-white with a deep brown transverse band around the mouth and the forehead, and an irregular spot of the same color on the top and on the front of each lobe. Thoracic legs dark brown; prolegs dusky.

*Descriptions and Natural History of two Insects which brave the dangers of *Sarracenia variolaria*.—Trans. St. Louis Acad. of Science. By C. V. Riley, Ph. D.

The newly hatched larva is pale, with the dark bands noticeable principally on joints 4-7, the head uniformly pale-brown, and the tubercles scarcely noticeable and surmounted by one or more stiff hairs. In the second stage the tubercles become more prominent, but those on joints 4-7 are not relatively so much larger than the others. In the third stage the characters of the mature larva are assumed, except that the colors do not contrast so greatly, the short hairs are not so dense and the head is often unicolored.

Chrysalis—Uncharacteristic; varying from yellowish-brown to mahogany-brown in color; the head produced into a slight cone in front between the eyes, and the tip of the abdomen armed, in perfect specimens, with two straight converging thorns, and several smaller curled hooks.

Imago—Average expanse 0.8 inch*. Colors, glossy straw-yellow and black. Primaries with the basal half straw-yellow, varying from pale chrome to ochre; the terminal half brown-black with a gray and violet reflection; the two colors sharply separated across the wing at about a right angle from costa. Secondaries same as terminal half of primaries, but usually somewhat paler, especially toward base. Under surface uniformly purplish-gray, inclining to yellow basally, and with a somewhat darker median shade usually discernible on primaries. Head black,† with palpi beneath and antennae yellow. Thorax of the same two colors, sharply separated across the shoulders. Legs yellowish, the tarsi with minute spines, the spurs often with a spinous tip. Abdomen yellowish at base, otherwise concolorous with secondaries.

The species is very variable, the dividing line of the two colors, on primaries, being usually across the middle, but in some specimens much nearer the base of the wing. A striking variety (two specimens) is of a uniform straw-yellow, with the faintest dusky shade across the middle and subterminal portions of primaries; while several have the dark parts more or less suffused with yellow.



SARCOPHAGA SARRACENIÆ—*G.* larva; *b.* pupa; *c.* fly, the hair lines showing average natural lengths; *d.* enlarged head and first joint of larva, showing curved hooks, lower tip; *e.* and prothoracic spiracle; *f.* end of body of same, showing stigmata (*g.*) and prolegs and vent; *h.* tarsal claws of fly with projecting pads; *i.* antenna of same. All enlarged.

never more than 8), which in their turn ramify into lobules. Anal stigmatic cavity quite deep; the fleshy prominences on the carina surrounding it, sub-obsolete; the stigmata but slightly excavated below, the border brown, enclosing three brown openings, the lower ends of which reach to a circular clear space in the corneous and pale rufous peritreme. Anal prolegs quite small, with the longitudinal anal slit between, and a corneous plate in front of them.

Puparium—0.25-0.50 inch long; neither smooth nor highly polished, and varying from yellowish-brown to deep brown-black in color. Insections more or less distinctly traceable. Head and prothoracic joint retracted; the prothoracic spiracles, protruding and forming two small ears, about as long as joint 2; the mass of lobules hardened and rufous. Joints 2 and 3 constricted and flattened; 4 suddenly bulging. End of body squarely docked by spiracular cavity, the rim of which forms quite a ridge.

Imago—Length of body 0.23-0.56 inch. Head pale golden-yellow, especially when viewed from above, with a dark brown or bronze sheen, especially below; eyes ferruginous, in life; duller and bronze-colored in death; stripe between the eyes and all appendages jet-black, though showing, in fresh specimens, shades of brown or yellowish-brown, especially at inner base of antennae and on maxillipalps. Thorax pale ash-gray, with three prominent, dark, longitudinal dorsal vittae, and two which are shorter, on each side; the two intervening pale dorsal spaces showing also a narrow darker line along their middle; wings slightly fuliginous; tegulae sordid white; legs black, with the front thighs grayish beneath; cushions large and pale yellowish. Abdomen of the same gray—inclining, in some specimens, to pale golden-yellow, especially behind—checkered with black, the pattern varying with each change of light, but 3 longitudinal lines tolerably distinct from above, the side ones approaching or joining the medial one on the anterior part of each joint, and the whole looking checkered as the light falls on the sides; anus always, and frequently the hind margin of preceding or 4th abdominal joint, pale reddish-brown, the color deepening and becoming less noticeable in the dead specimen; the globular and highly polished male genital organ of a brighter and deeper reddish-brown.

*The writer finds the extremes of his measurements 0.6 and 1 inch.

†The writer has observed some specimens with brown heads.

SARCOPHAGA SARRACENIÆ, Riley. Larva—0.30-0.85 inch long. Body composed of but 11 visible joints exclusive of the head; microscopically and transversely shagreened; transversely wrinkled, the hind wrinkle on each joint more particularly prominent laterally. Head extremely small, or $\frac{1}{4}$ as large as joint 1; showing a division into two maxillary lobes at the tip, and a larger labial lobe, beneath, with a small bunch of setous fibres issuing from it; the black retractile jaws, of the ordinary form, issuing between these lobes, and the antennae showing in two small rufous projections above the maxillary lobes; sparsely armed anteriorly with minute conical, sharp-pointed spines, decurved in front, directed backward beneath. Prothoracic spiracle pale rufous, retractile, sponge-like, studded with numerous lobules, divided at the end into a variable number of branches (6 being usually apparent, never more than 8), which in their turn ramify into lobules. Anal stigmatic cavity quite deep; the fleshy prominences on the carina surrounding it, sub-obsolete; the stigmata but slightly excavated below, the border brown, enclosing three brown openings, the lower ends of which reach to a circular clear space in the corneous and pale rufous peritreme. Anal prolegs quite small, with the longitudinal anal slit between, and a corneous plate in front of them.

REMARKS.—Though there is such great variation in size—depending, no doubt, on the amount of nourishment obtainable by the larva—there is not much in coloration. The species agrees so erably well with the description of *CARNARIA* except in having a red anus, and should perhaps be considered only a variety of this last.

The larva differs from Packard's description of that of *CARNARIA* in the character of the prothoracic spiracle, in lacking the 12 blunt spines around the anal spiracular region, and in having the clear space in the peritreme of the anal spiracles, by which it seems to agree more with his description of *Calliphora*.

I also find a fly frequenting the pitchers and living upon the remains at the base of the leaf that agrees with the description of *Sarcophaga carnaria* L., or the flesh-fly.

My attention has often been called to the fact that *Musca Caesar*, L., the blue-bottle fly, is found in the leaves of the Side-saddle flower as well as in some other forms of pitcher plants. (See page 409, Packard's Guide.)

I have often seen specimens of *Musca domestica*, L., the housefly, near the pitchers, but have never seen them inside except when dead. Neither have I been able to raise them from any of the larvæ. It is said, however, that they are known to live in the insect remains.

In answer to the question, "How do these insects succeed in escaping from the pitchers and have apparently perfect freedom in them," Dr. Riley suggests that in the case of the flies it is probably due to the large foot-pads and elongated claws that perhaps reach through the pubescens of the leaf and fasten to the cellular tissue beyond. Their great strength seems also to aid them in escaping by means of a continued buzzing and gradual movement upward. The only fly that seems to escape readily is the *Sarcophaga*.

The moth has the tarsi covered with long spines which are usually tipped with "a corneous point." The larvæ are perfectly safe in their web-like scaffolding.

Some time was spent in studying all these insects to see if they had any part in aiding the plant in fertilization. None of the insects living in the tube seem to ever frequent the flower. They are either there to feed upon the tissue of the leaf itself or are attracted by the odor of the decomposing mass to feed upon it.

As living insects prey upon the leaf and macerating mass so birds often frequent these leaves to feed upon the living insects. One is often surprised to see the number of ragged holes in the sides of, especially, old leaves. Some of these holes are made by insects in which case shreds of the epidermis still remain.

In several leaves that I knew had been opened by birds I did not find a single living insect. They seem to especially enjoy the fat larvæ of the *Sarcophaga* fly. It is a well known fact that birds when they obtain a taste of a new food that is especially enjoyable to them seemingly cannot be satisfied till there is no longer a supply. Perhaps this will explain the fact that in some localities the leaves will all be more or less torn while in others the leaves as a whole are without holes.

Though I have not been able to make any extended observation concerning the depredations of birds on the leaves, I have sufficient evidence to show that, in those years when the larvæ of the *Sarcophaga* fly are especially common, the birds prey to a great extent upon them.

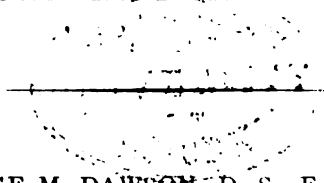


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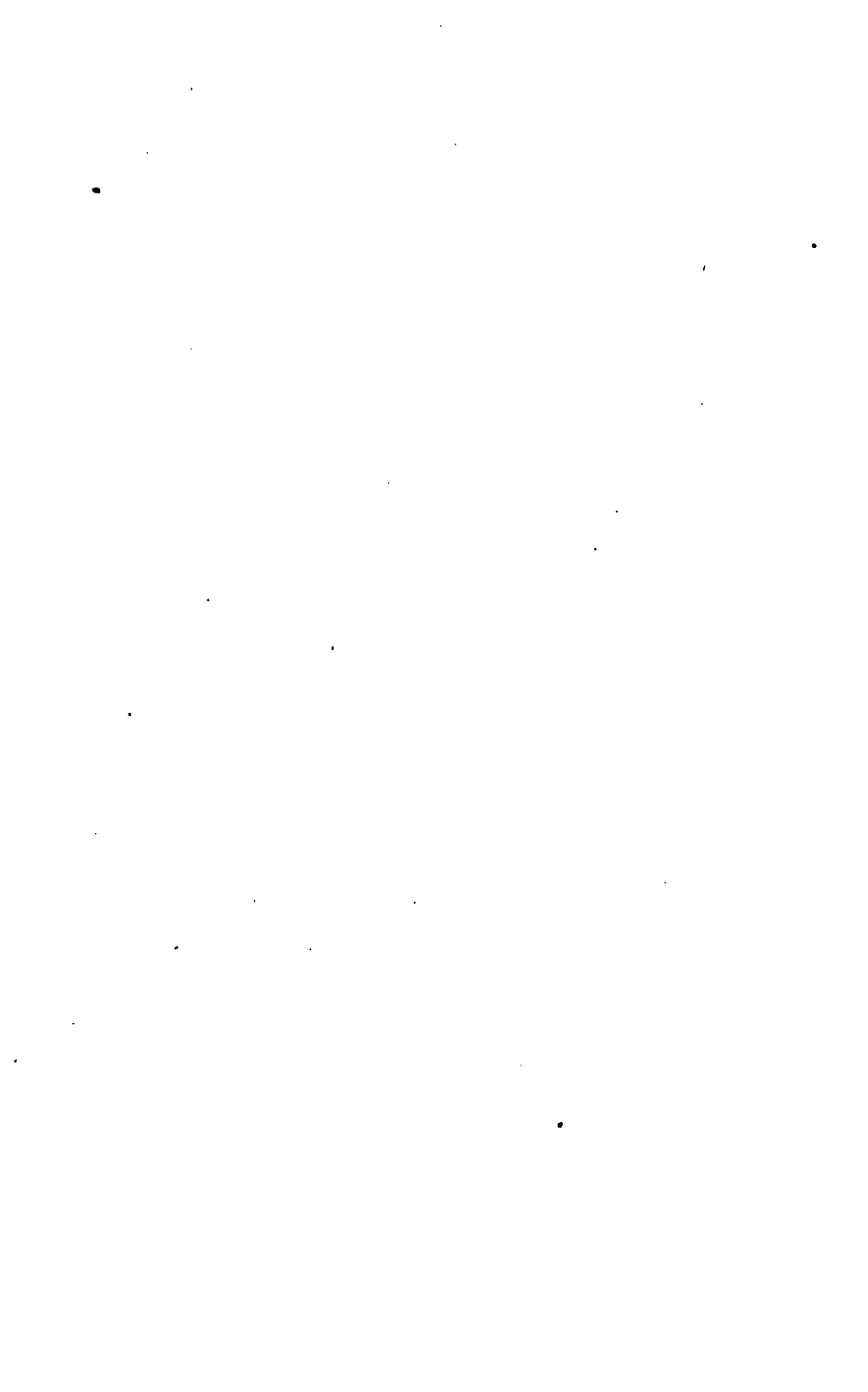
BOULDER CLAYS.
ON THE MICROSCOPIC STRUCTURE OF CERTAIN
BOULDER CLAYS AND THE ORGANISMS
CONTAINED IN THEM.



DR. GEORGE M. DAWSON, D. S., F. G. S., &c.,

Assistant Director of the Geological Survey of Canada.

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BOULDER-CLAYS.

ON THE MICROSCOPIC STRUCTURE OF CERTAIN BOULDER-CLAYS AND THE ORGANISMS CONTAINED IN THEM.

BY DR. GEORGE M. DAWSON, D. S., F. G. S., F. R. S. CAN., ASSOCIATE
R. S. M., AND ASSISTANT DIRECTOR OF THE
GEOLOGICAL SURVEY OF CANADA.

(READ BEFORE THE CHICAGO ACADEMY OF SCIENCES JUNE 9, 1885, BY H. A. JOHNSON, M. D., F. R. M. S.)

In a paper read before the Academy in January, 1884, and printed in the bulletins of the Academy (vol. i, No. 4), H. A. Johnson, M. D., and B. W. Thomas, F. R. M. S., gave the results of an investigation by them of microscopic organisms in the boulder clay of Chicago and vicinity. This paper refers principally to certain remarkable bodies first found by these gentlemen in 1865-66-67, in specimens of the clay through which the lake tunnel, which supplies the city of Chicago with water from Lake Michigan, was being constructed. On the completion of the tunnel large numbers of the same bodies were observed in the filtrate from the city water supply, and which were subsequently proved to be identical with organisms described in 1871 by Sir J. W. Dawson from the Devonian shales of Kettle Point, Lake Huron. They have since been observed in the Devonian rocks of a number of widely separated localities, and are now believed by Sir J. W. Dawson to be macrospores of rhizocarps.* In accordance with this view the generic name of *Protosalvinia* is proposed by Dawson in the paper above referred to instead of *Sporangites*, which term is, however, still used in this paper. Properly speaking, this term would apply to the *Sporangia* containing these macrospores, and which are absent in the specimens in question. Mr. Thomas, in a note to the paper first quoted, refers to the additional discovery in boulder-clay from Minnesota, sent to him by Prof. N. H. Winchell, of several species of *Foraminifera*, evidently derived from the Cretaceous rocks of that region. Since

*Proc. A. A. A. S., 1883, and Can. "Record of Science," vol. i. See also paper by Mr. J. M. Clarke, American Journal of Science, vol. xxix, p. 284.

this announcement Mr. Thomas has mounted for the microscope and examined many samples of boulder-clays from various places, and has favored me from time to time with a number of his preparations. He has also kindly prepared and mounted specimens of several boulder-clays and allied materials collected in Manitoba and the Saskatchewan region. At his request the notes made by me on these last and on a few of those first mentioned are here offered. This paper must, however, be understood to be merely of a preliminary and general character, being based on the examination of less than one hundred microscopic preparations. It may, it is hoped, be supplemented later by a more detailed report, including the discussion of a larger suite of specimens, from a greater number of localities.

The microscopical investigation of these boulder-clays has resulted in the discovery of many objects which, while evidently of organic origin, are very difficult to name or classify, and require comparison with a wide range of bodies and reference to many works for that purpose. Mr. Thomas has also found that even in the case of those clays with which he is most familiar, each new lot of preparations mounted is almost sure to show forms not before observed, and that the field is an ever-widening one.

It is now, therefore, proposed merely to denote the classes of objects so far observed in the various boulder-clays, and when possible the genera to which the organisms belong, without attempting to catalogue them specifically. Neither is it here intended to enter into any further discussion as to the nature of the Macrospores occurring in some of the clays.

It should also be stated that most of the objects on the many slips examined, have been indicated by maltwood markings by Mr. Thomas, a circumstance greatly reducing the amount of labor involved in going over the material.*

BOULDER-CLAYS OF CHICAGO AND VICINITY.

The preparations examined representing the boulder-clay of Chicago and vicinity are as follows: From Chicago lake tunnel, 86 feet down, 5 slides; North Chicago boulder-clay, 60 feet down, 11; North Chicago clay, 64 feet down, 2; North Chicago, 65 feet down, 10; corner of Washington and Clark streets, eight feet down, 1; or 29 in all. These are so similar in their general characters and the class of objects which they present that they may be considered together.

The inorganic material in these clays, as represented by the above preparations, consists largely of quartz sand, in which few well-rounded grains appear, most being sub-angular and many quite angular and unworn. With these is a notable proportion of bottle-green particles of hornblende,

*It should be explained that the material referred to in the succeeding notes is that part of the boulder-clay which is composed of particles of medium size, from which the very fine matter has, as a rule, been separated by decantation. This again has been sized by repeated decantations at intervals of one, two or three minutes. Mr. Thomas states that the greater number of examples of a given form are frequently thus obtained in material of a certain grade of fineness.

with a few of mica and feldspar. Nearly one-half of the entire material is, however, composed of flattened and rounded grains of fine shale, which have a dark brown color and granular texture by transmitted light. One or two of the quartz grains show included crystals, and many hold fluid or gas cavities. The bodies of organic origin most commonly met with are referable to *Sporangites* (*Protosalvinia*) *Huronensis*, Dawson, of the Devonian shales. These are extremely abundant, and the shale particles already described are doubtless derived from the disintegration of the same beds. They are in some instances very well preserved, but are also present in all stages of decay, and in many cases hold a quantity of granular, shaly, or clayey matter in their interiors. Besides these a specimen occurs in the material from the lake tunnel of entirely different character. It is a partly flattened sphere of 0.2 m. m. in diameter, with radiating and concentric structure, brownish color, and very small central cavity, or nucleus. This is similar to some of the bodies from the Devonian rocks described as macrospores by Mr. Clarke in his paper above referred to. Two more bodies of the same class appear in other preparations, but are more nearly transparent, and evidently in a different state of preservation. To one of them a small fragment of the matrix attaches and serves to show that both of these may have come from a lime-stone bed.

Next in abundance to the *Sporangites* is a class of bodies the true nature of which is very doubtful. Of these at least twelve large fragments were noted in the preparations under discussion, with many smaller and less characteristic pieces. They may be described as spines or spicules, generally cylindrical, but sometimes trough-shaped or triangular in cross-section, averaging about .05 m. m. in diameter, and of pale yellowish brown color. Their structure is very finely granular, and the outer surface more or less roughened, as though from erosion. They are in some cases distinctly tubular, with a small central cavity; others have a thick medullary portion, which is poorly defined, but differs somewhat in texture from the exterior. Some of the fragments terminate in acute points, others have a slightly swollen, rounded end, and one was observed to be doubly terminated and nearly spindle shaped. They appear to be calcareous, but whether this is their original condition, or the result of mineralization, is uncertain. They can scarcely be chitinous, being much paler in color than other specimens of this character met with in some of the preparations. So many organisms may have produced spines or spicules resembling these bodies that it is not yet possible to assign them definitely. They do not appear to be sponge spicules, but as their color and texture is not unlike that of the next class of objects, they may possibly be partly mineralized chitinous setæ of Annelids, derived from some of the subjacent rocks. Their diversity in shape is such that they must either represent several species or belong to different parts of some organism in connection with which several types of appendage of this character were developed. (Fig. 1.)

Among the most interesting bodies found in these clays are certain comblike objects which are regarded as Annelid jaws. Of these, four, all fragmentary, have been observed. They were at first supposed to be teeth from the lingual ribbon of some mollusk, but on more careful examination were found to be unlike the teeth of any mollusk of which figures can be found, and, moreover, to correspond almost exactly in form with some of the Annelid jaws described by Mr. G. J. Hinde from the Silurian and Devonian rocks of Canada.† One of the specimens shows a series of long and curved prongs. (Fig. 2.) Three others apparently belong to a single type, in which a nearly flat plate is armed along one edge with a series of small, close denticles arranged somewhat obliquely to the line of attachment. (Fig. 3.) Like the bodies last described they are of a pale straw color, differing in this respect from Mr. Hinde's specimens, which are said to be shining and black; but this difference may arise from the mode of preservation. They exhibit no reaction with polarized light, and are smooth and not distinctly granular. The ends of the prongs or denticles are worn and roughened as though by use.



Fig. 1 (x130)



Fig. 2 (x130)



Fig. 3 (x130)

Organisms from the Chicago boulder-clays.

Other bodies occurring in these preparations in smaller numbers need not be referred to in detail. Two broken specimens evidently represent Ostracoda. They show no well marked sculpture, but a minutely granular structure. The most perfect is .31 m. m. in length. A third specimen, somewhat larger, and also broken, is either a small Sphærium or a very young specimen of some larger shell. All three have adhering to them brownish shaly particles, which appear to indicate their origin, though it must be remarked that the shell substance is very well preserved and fresh-looking. Still another specimen is a broken piece of the edge of a large calcareous shell or carapace, beautifully marked, and possibly that of an ostracod of another species. The remaining objects observed are mere fragments, quite indeterminate in character. Among these are small pieces of a delicate ribbed shell, the ribs being square in cross-section; a rather large chitinous fragment, striated externally, but without any other apparent structure, and one or more pieces of straight tubular siliceous spicules probably belonging to some sponge.

The probable sources of the organic bodies in these clays is discussed subsequently in connection with those from other places.

† Quarterly Journal of the Geological Society, 1879, p. 370.

BOULDER-CLAYS FROM BLOOMINGTON, ILL., 107 FEET DOWN.

This clay immediately underlies an interglacial deposit of soil and peaty matter with remains of wood, etc.* Of this clay five preparations only have been examined. The coarse material is here chiefly quartz sand, of which by far the larger proportion is sub-angular. There are also a few grains of amethystine quartz, showing sharp conchoidal fracture. Several quartz grains show inclusions, one of very small hexagonal red crystals, probably hematite. Hornblende grains are moderately abundant, but shaly fragments, such as those which make up a large proportion of the material from the Chicago clays, are almost or altogether wanting. A few Macrospores exactly like those previously noticed occur, together with one or two specimens of the pale brownish granular spines, or setæ, found in the Chicago clays. A small, flat, curved, finely-ribbed body in one of the slips resembles part of the edge of a carapace. While therefore not altogether wanting in this clay, organic traces appear to be very scantily represented.

BOULDER-CLAYS FROM MEEKER COUNTY, MINN.

This material is derived from a well shaft sunk in Meeker County, at a depth of about twenty-two feet, and was transmitted to Mr. Thomas by Prof. N. H. Winchell, State geologist of Minnesota. Mr. Thomas has made a large series of preparations from it, a number of which I have had the opportunity of inspecting.

As the Foraminifera contained in these preparations are being named and catalogued by Messrs. A. Woodward and B. W. Thomas, the remarks here given are confined principally to the general character and contents of the clay, with the object of comparing it with those from other localities.

The coarser material from this clay, as it appears in the preparations, is chiefly quartz sand, which is generally sub-angular, though with some well-rounded grains. Hornblende and mica appear in about the usual proportions, and two quartz grains with very beautiful inclusions were noticed, one being probably either hornblende or rutile, the other possibly apatite. A large proportion of the material, however, consists of rounded grains of shale, of gray or greenish-gray color by transmitted light, and not nearly so dark as the shale mixed with the Chicago clays. In specimens boiled in nitric acid, the shaly fragments have become reddish from the oxidation of their iron.

Of organic bodies present in these specimens of Minnesota clay, the *Foraminifera* are most prominent and important. They are evidently derived from the Cretaceous strata, and resemble those found in the western development of these rocks, both specifically and in mode of preservation. *Rotalidæ* and *Textularidæ* are most abundant, though specimens of *Globigerina* and other genera also occur. Next in abundance to the *Foramin-*

*This stratum of soil is about 6 feet thick, and underlies 101 feet of boulder-clay. I do not know the thickness of the clay deposit below the inter-glacial soil, but both the upper and lower clay deposits carry an abundance of glacial-marked boulders.—B. W. T.

ifera are remains of *Radiolaria*. Some difficulty was experienced in deciding the true nature of fragments of these bodies at first met with, but the subsequent discovery of numerous and often well-preserved specimens, and the observation by Mr. Thomas that they resist boiling in nitric acid, now leave no doubt as to their character. Several genera and quite a number of species are represented, and it will eventually be possible to determine many of these forms specifically. Most appear to belong to the Polysphæridæ and Cystidæ of Haeckel's classification. The constant occurrence of these bodies with the Cretaceous Foraminifera in the Minnesota preparations and in those from other places, with their absence from materials not equally characterized by the Foraminifera, leaves little room to doubt the common origin of both. Among miscellaneous objects from the Minnesota clay may be mentioned a few fragments apparently identical with the minutely granular spines or setæ described as occurring in the Chicago clays; also two broken portions of stout siliceous spicules, about .026 m. m. in diameter, one smooth, the other tuberculated; both tubular, and probably belonging to some sponge. Lastly, a single specimen of a very curious body, of straggling and irregular form, composed of numerous expansions differing in shape and size and pretty uniformly pitted and connected by narrow, smooth necks. As this is in one of the preparations which has been treated with acid, it must be siliceous. I can only suggest that it may be the siliceous cast of some foraminifer like *Aschemonella catenata* of Norman the arenaceous test of which has been composed of calcareous particles which have left pitted impressions on the cast. Against this is the fact of its small size, it being about .2 m. m. only in greatest diameter.

BOULDER-CLAY FROM CRETE, SALINE CO., NEB.

This material, Mr. Thomas informs me, was obtained from a single small excavation. It was forwarded to Mr. Thomas by Prof. G. D. Swezey, and is described by him in a letter to Mr. Thomas as a blue clay underlying the loess. The inorganic matter in the preparations made from it consists largely of fine angular and sub angular quartz grains, with a small proportion of green hornblende and much shale or earthy limestone in little particles which differ in color and texture. It is extremely rich in organic forms, chiefly Cretaceous Foraminifera, so much so that it seems probable that it is largely composed of the debris of the Niobrara division of that formation, and that a complete study of its contents would practically include that of all the forms occurring in the chalky limestone of that stage. The present notice of it must therefore be considered as of the most general and preliminary character only. Of this material a suite of thirty-one preparations has been examined, and in an enumeration of about one hundred of the best preserved forms, nearly fifty per cent belong to the *Textularidæ*, the remainder being made up in nearly equal proportions of *Globigerinidæ*, *Rotalidæ*, miscellaneous *Foraminifera* of other families, and *Radiolarians*,

resembling, and in some cases identical with, the Minnesota species. Fragments of calcareous prisms from the shell of *Inoceramus* and in the finer matter specimens of *Coccoliths* and *Rhabdoliths* also occur; all resembling in every respect similar bodies found in the Niobrara rocks of Nebraska and Manitoba.*

Many of the Foraminifera are completely filled with calcite, while others are still partially hollow, and yet others are filled partly with calcite and partly with black carbonaceous or bituminous matter. Of objects of an unusual character two may be specially referred to. A rod-like body about .2 m. m. in length, narrowed near the middle, though broken at one end, and marked by numerous pits in linear series. This may be a small spine from some *Echinoderm*. Also a hollow conical tooth or spine, evidently that of a fish, also broken, but still .25 m. m. in length.

BOULDER-CLAY FROM A WELL AT ROSENFELD, MANITOBA.

This material, sent to me under the name of "Hard-Pan," was obtained at a depth of 135 feet, in a well bored by the Canadian Pacific Railroad Company at Rosenfeld, Manitoba. It formed, mixed with gravel and boulders, a layer of eighteen feet in thickness, below the post-glacial alluvial deposits of the Red River Valley and resting on a Silurian shale. As the well was bored with an ordinary percussion drill, it is possible that some matter from the alluvial deposits above referred to may have been mixed with the specimen of "hard-pan," but so far as examined these alluvial deposits do not hold any organic forms. Numerous small particles of steel from the edge of the drill occur in the six preparations representing this clay.

The inorganic constituents are coarse in texture; quartz grains, of which nearly one-half are perfectly rounded, as usual predominating. Bottle-green hornblende is moderately abundant as are also fragments of feldspar and limestone, but shaly materials are almost altogether wanting. Bodies of organic origin are rather scarce, Foraminifera, however, being most common, and a Textularia of the type of *T. globulosa* is characteristic. A few Rotalidæ are also present, with broken chambers of other Foraminifera. The examination of a greater quantity of the material would doubtless lead to the discovery of all the ordinary Cretaceous types.

BOULDER-CLAY FROM THE SOUTH SASKATCHEWAN RIVER TEN MILES EAST OF THE MOUTH OF THE SWIFT CURRENT.

This and the two following localities in the Canadian northwest territory are represented by specimens collected by Mr. R. G. McConnell. The three localities lie between the 106th and 108th meridians, and represent a portion of the great drift-covered area of the northern plains. The material from this place is, as usual, largely siliceous, but there is a larger proportion

*See a paper by the writer in the Canadian Naturalist, 1874.

than common of coarse, thoroughly-rounded quartz grains. Hornblende and other crystalline minerals from the Laurentian or Huronian are also present, and there is a notable quantity of amethystine quartz in angular fragments. Comminuted gray shale, very finely ground, is moderately abundant. Bodies of organic origin are not frequent. In pretty carefully examining a series of six preparations, about ten only were met with. These are *Textularia* and rotaline *Foraminifera*, with one very small *Globigerina* and a couple of *Radiolarians*; one very perfect, oval and .09 m. m. longest diameter. (*Haliomma*?) A fragment was also found of bony substance, showing haversian canals and probably portion of a ganoid scale. There is also in these preparations a number of rounded and flattened grains, nearly transparent, though in some cases with a more opaque central spot, and surface minutely and regularly roughened. These were eventually determined by comparison to be fragments of some pearly shell, probably that of *Unio*, a form quite abundantly represented in the Cretaceous and Laramie rocks of the region. The appearance of an opaque nucleus in some examples appears to result from the non-penetration of the mounting medium to the centre of the larger grains.

BOULDER-CLAY FROM TEN MILES NORTH OF THE SOUTH SASKATCHEWAN, EAST
OF MISSOURI COTEAU, TOWNSHIP 21, RANGE 10, WEST OF 3D PRINCIPAL
MERIDIAN.

The material in six preparations from this clay differs from the last described only in the much greater quantity of comminuted shaly matter of a reddish-brown tint. Bodies of organic origin are here again scarce. No *Foraminifera* were found. Two or three broken pieces of minute rod-like pitted objects, very doubtfully referred to small spines of some *Echinoderm*, and evidently identical in character with that previously described from Saline County, Neb., were detected. Those occurring here are about .015 m. m. in diameter. Another somewhat similar object is rather stouter and with a roughened surface without regular markings. A small broken piece of some chitinous test was also observed, but on the whole this material is very barren.

BOULDER-CLAY FROM THE SOUTH SASKATCHEWAN, FIFTEEN MILES ABOVE THE
ELBOW.

In the preparations from this clay—eighteen in number—the sandy material is much finer than in the two last. It is nearly half composed of shaly fragments of brown color, the quartz sand being also rather more angular than usual. It is richer in organic forms than either of the other specimens from the neighborhood of the South Saskatchewan. About half a dozen specimens of *Foraminifera* were recognized in the preparations, one being probably a small *Discorbina*, others *Textularia* and broken chambers of *Globigerina*. These are not so well preserved as in some of

the other clays, and in some cases the shell itself appears to have been removed, leaving only a rough cast in calcite. *Radiolarians* are here (so far as the examination of a small quantity of material can be accepted as conclusive) even more abundant than *Foraminifera*, spherical, oval and turbinate forms all being represented, and in some cases in such connection with fragments of the abundant shaly material as to leave no doubt as to their common origin with it. Small, partly rounded prisms from the shell of *Inoceramus* are also present, together with a few pieces of straight hollow siliceous spiculæ, one specimen of a minutely granular spine or seta, with a distinct medullary portion like some previously noticed, and .026 m. m. in diameter, and one of a portion of a body like that previously referred with doubt to an *Echinoderm* spine.

CONCLUSIONS.

In inquiring as to the derivation of the various organic bodies in the clays, it is necessary to consider the situation of each locality with reference to known areas of the older rocks, from the disintegration of which they may have come. The *Sporangites* so abundant in the Chicago clays have been definitely traced to the shales of the Devonian age, and have doubtless been brought to their present position from outcrops to the northward in the Michigan peninsula. It has already been stated that the bodies supposed to be Annelid jaws may probably have been derived from the same beds, or from others of the Devonian or Silurian rocks of this part of the country. With regard to the remaining bodies no definite statement can at present be ventured, though there is every reason to believe that they might very well have come from the same rocks.

In the clays from Bloomington, in the center of the State of Illinois, *Sporangites* are again the most characteristic bodies, though much less numerous in correspondence with the greater distance from the shale outcrops. A few other objects associated with these are not dissimilar to those in the Chicago clays.

Meeker County, from which the specimens of Minnesota boulder-clay were derived, is in the southern and central portion of the State, and is underlain, according to Prof. N. H. Winchell by rocks of the Archæan period, overlain probably, at least in some places, by shales of the Cretaceous. As might be anticipated from the absence of Devonian rocks, both in this locality and the whole region to the north and northeast, *Sporangites* have not been observed in this clay. While the greater part at least of the organisms are evidently referable to the Cretaceous rocks, the locality lies to the northeast of the generally recognized edge of that formation. Prof. Winchell has, however, proved the existence of a number of outliers of Cretaceous beyond the main area occupied by these rocks, and it is probably from one of these, possibly not remote from the actual position of the clay, that the *Foraminiferæ* and *Radiolarie* have come.

The clay from Crete, Saline Co., Neb., is, as already observed, so rich in Cretaceous forms as to lead to the belief that it is largely composed of the debris of the chalky limestone of the Niobrara stage, and may rest upon or lie very near to the outcrop of these beds. I am not in a position to state whether the geology of the district bears out this conclusion. The map shows at least that Cretaceous rocks underlie this part of the State.

The material from Rosenfeld, Manitoba, shows a smaller number of forms, but these are equally characteristic of the Niobrara stage, the outcrop of which, though concealed by alluvial and other deposits, can not be many miles west of the position of the well, and also runs northward along the base of the Pembina escarpment, having been recognized at a point about fifty miles northwest of Rosenfeld on the Boyne River. ("Geology and Resources of the 49th Parallel," p. 78). As there is little probability of the existence of any Cretaceous rocks directly north or to the northeastward of this place, the occurrence of Cretaceous Foraminifera would tend to show that material derived from the northwest had been incorporated with the boulder-clay of this district.

The three localities near the South Saskatchewan may be treated of together, in so far as the origin of their organic constituents is concerned. The general movement of the material composing the glacial deposits of the northern plains in a southwesterly direction has already been demonstrated (see "Quarterly Journal of the Geological Society, 1875," p. 605; "Report of Progress of the Geological Survey of Canada, 1882-84," p. 139), and it would appear that the Cretaceous Foraminifera must also have been carried from the vicinity of the eastern Cretaceous outcrops at a great distance. It is true that the clays here rest on Cretaceous beds, but these are not as a rule calcareous, or such as to yield Foraminifera in the state of preservation of those found in these clays. The Niobrara limestones are not only unknown in the entire district from which the clays come, but their place appears to be taken in this region by the Belly river beds, which are arenaceous and argillaceous. Other organic fragments present in these clays may well have been derived from the Cretaceous or Laramie beds of the immediate neighborhood.

In reviewing the general bearings of the microscopical examination of these boulder-clays, representing as they do a few points only, scattered over a wide area in the central portion of the continent, it would be unwise to endeavor to draw any very definite or too general conclusions. The field appears to be a promising one for future inquiry, and the present paper can be regarded only as in the strictest sense, preliminary. It would appear, however, that of all the organic bodies met with none can be assigned with certainty to the glacial period or era of deposition of the boulder clay itself. The origin of most can be traced unequivocally to the older rocks, from which they have been derived, and incorporated with the boulder-clays. Of all the bodies enumerated the only ones which, on account of their pres-

ence in clays, holding otherwise different sets of forms, may possibly be of contemporaneous origin with them, are siliceous sponge (?) *spicules* and the peculiar spines or setæ several times referred to in the foregoing. To these may be possibly added the Ostracoda from the Chicago clay. While it is therefore probable that the examination of these organic fragments will serve to throw additional light on the direction of transport of material during the Glacial period—a point of particular value over the wide area of the plains, where the soft character of the rock precludes the test of direction of striation—it has so far failed to afford any certain information as to the actual conditions prevailing during that period. The negative evidence, reinforced by the fact that derived bodies have been perfectly preserved, so far as it goes, leads to a belief in the great scarcity of contemporary life. The occurrence of inter-glacial peats and the inclusion of wood and other vegetable matters in the boulder-clays of a number of widely separated localities in the West (see “Vegetable remains in Drift Deposits of the Northwest,” by Prof. N. H. Winchell, Proc. A. A. S., 1875; “Report of Progress of the Geological Survey of Canada, 1882–84,” p. 144) prove, however, that life was not constantly absent, and it may therefore reasonably be anticipated that further search will eventually lead to the definition in the clays of at least such contemporary organisms as may have been derived from these inter-glacial deposits, and possibly of others strictly contemporaneous with the boulder-clays themselves. The well-rounded character of a considerable proportion of the sand in some of the specimens points to prolonged water action, but there is no means of deciding to what extent in each case previously rounded sand grains have been included in the clays. The comparatively unworn appearance of the majority of the Foraminifera and other delicate objects, on the contrary, indicates rather tranquil conditions of deposit, and negatives the occurrence in the case of these materials of any extensive differential motion in the substance of the clay itself, which would infallibly have destroyed these very fragile organisms. Mr. Hugh Miller, in a carefully worked out paper on “Boulder Glaciation” (“Royal Physical Society, Edinburgh,” vol. viii, p. 157), describes a fluxion structure in the Scottish till or boulder-clay, and notes instances of sand grains so shaped and striated as to represent microscopic glaciated boulders which he conceives to have been “slidden along and glaciated in these places in the clay.” No confirmation of this observation is afforded by these clays. Though many grains of an elongated shape show what might at first be taken for such striation, it is apparent in almost every case on close examination that the lines are really structural and that the shape of the grains is here, as in ordinary sands, governed to a great extent by the pre existing cleavage or jointage planes of the material of which they are composed.

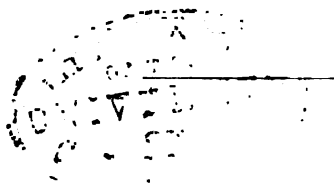
The microscopical examination of these boulder-clays bears out the conclusion arrived at from their macroscopic characters that, while largely composed of far-traveled material, they invariably contain a considerable proportion of material of local, or proximately local, origin.

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SOME POINTS
ON THE
MICRO-CHEMISTRY OF FATS.

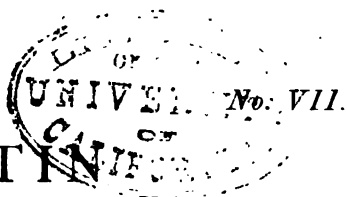


By JOHN H. LONG, Sc. D.

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SOME POINTS ON THE MICRO-CHEMISTRY OF FATS.

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Before the beginning of this century investigations concerning fats and oils were confined almost entirely to the preparation of a few soaps, plasters and burning fluids. The action of alkalies on fats was explained by assuming that the two classes of bodies united without excluding any thing. Even the fact that a metallic compound, as lead acetate, could precipitate an alkaline soap, seemed to suggest little. Scheele, in 1779, separated glycerine from olive oil, and later, from other fats; but, like Priestley, wedded to the old Phlogiston theory, he failed to perceive the great importance of his discovery.

The first satisfactory explanation of the nature of fatty bodies was furnished by the work of Chevreul, commenced in 1811, and by the analyses of others, who, taking up the investigations suggested by this chemist, soon showed the general correctness of his views. Fats were thus proven to be ethers of organic acids, in which glycerine was usually the basic part, and saponification, accordingly, consisted in replacing this glycerine by a metallic oxide. The investigations of Wurtz on the composition of glycerine, and of Berthelot and Heintz on the synthesis of fats, bring this part of the subject down to the present time.

The constitution of these bodies being settled, it now remained to study their various reactions, and improve methods of separation and identification.

We may regard the following formulas as established:

		Molecular weight.
Glycerine	$(C_3 H_5 O_2)_3$	92
Stearic Acid	$(C_{18} H_{35} O_2) H$	284
Palmitic Acid	$(C_{16} H_{31} O_2) H$	256
Oleic Acid	$(C_{18} H_{33} O_2) H$	282
Butyric Acid	$(C_4 H_7 O_2) H$	88
Caproic Acid	$(C_6 H_{11} O_2) H$	116
Tri-stearin	$C_3 H_5 (C_{18} H_{35} O_2)_3$	890
Tri-palmitin	$C_3 H_5 (C_{16} H_{31} O_2)_3$	806
Tri-olein	$C_3 H_5 (C_{18} H_{33} O_2)_3$	884
Tri-butylin	$C_3 H_5 (C_4 H_7 O_2)_3$	302
Tri-caproin	$C_3 H_5 (C_6 H_{11} O_2)_3$	386

With very few exceptions, all natural fats consist of mixtures of the last five bodies, and numerous processes have been suggested for separating the constituent parts.

A rough separation can be effected by partial crystallization from some menstruum, or by melting and cooling gradually, in which case the more solid fats separate first.

Fats containing volatile acids can be treated in this way: They are first decomposed by saponification, and treated with dilute sulphuric acid to throw out the free fatty acids. The volatile ones, as butyric, can now be distilled off, or washed out by hot water, in which they are soluble. Methods of analyzing butter are based on these principles. The separation of stearic, palmitic and oleic acids from each other is a problem of very great difficulty, and can be best accomplished in this way, as given by Oudemans (*Fres. Zeit.* 1867, p. 454.) After saponification and precipitation of the fatty acids, an alcoholic solution of the latter is prepared, from which lead acetate throws down the lead salts. These are dried and treated with ether, in which oleate of lead is soluble, while the stearate and palmitate are not. The acids can be separated from the lead readily and weighed, or further treated. The method is not very accurate, as the lead oleate is not easily soluble in cold ether, while, if the latter is warmed, small amounts of the other salts pass into solution.

Palmitic and stearic acids are separated from each other by the process of Heintz. The mixture is dissolved in hot alcohol, and treated with a hot alcoholic solution of magnesium acetate, in such proportion that only about one-seventh of the amount necessary for total precipitation is added. Under these circumstances nearly pure magnesium stearate separates.

From the residue a second and third precipitates are made, and so on. The final ones consist chiefly of magnesium palmitate.

By decomposing all the fractions and repeating the process, it is possible to obtain the one acid in several portions practically free from the other. By uniting and weighing the fractions the desired result is obtained. This process was proposed by Heintz in 1851 (*J. B.*, 1851, p. 639). and modified by himself and others later.

As an analytical method it is seldom followed, but for obtaining the pure acids for experimental purposes it answers very well, and was employed by Heintz in preparing the materials for his work on the synthesis of fatty bodies.

The determination of the amount of stearic and palmitic acids in a mixture is usually accomplished by this indirect method.

The molecular weight of stearic acid being 284, and that of palmitic being 256, one C.c. of a $\frac{1}{10}$ normal sodium hydrate solution would neutralize 28.4 Mg. of the former and 25.6 Mg. of the latter. By a simple calculation from the weight of the mixed acids taken, and the C.c. of alkali used, the proportions of the two acids may be deduced. The method is fairly accurate when due precautions are taken. The acids must be dissolved in pure alcohol, or alcohol of known acidity, and a proper indicator, as phenol-phtalein, must be used.

Account must also be taken of the fact that the free acids hold some water, about 3.25 per cent. These equations may be employed in calculating the amounts of acid in such a mixture:

$$\begin{array}{ll}
 \text{Let} & x = \text{wt. of stearic acid.} \\
 & y = \text{wt. of palmitic acid.} \\
 & a = \text{wt. of mixture.} \\
 & b = \text{wt. of Na O H used.} \\
 \\
 \text{Then} & x + y = a \\
 & \frac{10}{284} x + \frac{10}{256} y = b \\
 \text{From which} & x = 10.143 a - 64.914 b
 \end{array}$$

A determination of the fusing point of a mixture of the two acids may give some idea of the amounts of each present, but the uncertainties of the method are sufficiently indicated by this table:

Stearic.	Mixture of Palmitic.	Melts.	Solidifies.	Texture.
100	0	69.2	69.2	Crystalline scales.
80	20	65.3	60.3	Fine needles.
60	40	60.3	56.5	Non-crystalline.
40	60	56.3	54.3	Large plates.
30	70	55.1	54.0	Non-crystalline.
20	80	57.5	53.8	Indistinct needles.
0	100	62.0	62.0	Scales.

To be of value these tests must be made with very great accuracy, and both melting and solidifying points must be found.

In practice, the processes mentioned prove of little value in the identification of a majority of the natural fats. In some cases so-called color tests are of use here. These depend on the tints produced by certain reagents when mixed with different fatty bodies, and among the reagents may be mentioned sulphuric acid, nitric acid, zinc chloride, sodium hydrate, hydro-chloric acid and sugar, and several others. At first sight,

one may be pleased by the simplicity of these tests, but on trying a large number uncertainty creeps in, when it is found that various mixtures may be made to yield the colors supposed to be characteristic of some one substance.

It has been known for a long time that nearly all fatty bodies will crystallize under appropriate conditions, and in forms which are, to a certain degree, characteristic.

The study of a few of these fatty crystals is the main object of this sketch. The literature of the subject is meager and very unsatisfactory. Several authors since Chevreul, Berthelot and Heintz, have referred in a general way to the crystalline forms assumed by natural and artificial fats when crystallizing from various solvents, but evidently, no very great importance was attached to these observations. Attempts were made to distinguish between butter and some of its substitutes by microscopic tests, it being claimed that pure butter was characterized by an absence of small crystals, while other fats, used to adulterate it, possess a multitude of these, especially visible when viewed by polarized light. Some ten years ago, Hassall, in his work on food adulterations, showed the fallacy of this, which fact, however, seems to have been lost sight of by later observers. In a French scientific paper I found, some years ago, reference to the crystallization of certain animal fats, with the statement that from this could be developed a means of identification. Unfortunately, I have lost my memoranda relating to this paper, and can not now recall where I saw it. I think it was published between ten and fifteen years ago, and it was among the first notices relating directly to identification.

In the last five years the subject has received more attention. The following pages embrace the results of my own experiments, commenced in the winter of '82-'83, and which are still in progress. In my investigations I have tried several methods of preparation for microscopic examination.

First Method. Small portions of the fats in question were pressed down to a thin layer between a cover glass and slide, and then examined by ordinary and polarized light, using powers from 75 to 250 diameters. In this way crystals already existing can be detected, but in most cases there is little characteristic about them. Below, under the discussion of butter, it will be seen what use can be made of them.

Second Method. Here a small fragment of the solid fat was melted on a slide, and allowed to cool slowly. In this manner crystals can be obtained, but solidification is usually too rapid to permit large and characteristic forms to appear. By softening the fat by addition of a little olive oil, somewhat more satisfactory results can be obtained, but in

neither case is a free and perfect crystallization possible, as in the following methods.

Third Method. This is the ordinary procedure of crystallization from solution. A small amount of fat was dissolved in ether, carbon bisulphide, chloroform or other menstruum in a beaker or watch-glass, and allowed to stand, until by spontaneous evaporation most of the liquid had passed off. After removing the mother liquor, the deposited crystals were examined on slides in the usual way.

In this way very perfect crystals can be made, but they are not as sharp as when made as follows.

Fourth Method. Here the fats were dissolved as before, and a drop or two transferred to a slide. In a short time, by spontaneous evaporation, a film makes its appearance on the surface of the drop, and at this stage a cover is carefully placed over it, and the slide is allowed to stand until complete crystallization takes place. This requires, in some cases, but an hour, while in others a day or more is necessary. Of all solvents I have found chloroform the most serviceable, and nearly all the crystals described below were made by its use.

I pass now to a discussion of the several fats.

BUTTER.

I have above referred to the opinion once held, that pure butter is composed of non-crystallized fats, and when viewed by polarized light exhibits no refraction phenomena. Hassall and others, as mentioned, have pointed out that on standing, butter soon loses this peculiarity. It has also been found that perfectly fresh butter, and even cream, may sometimes show crystalline forms.

I have been able to confirm these observations as regards butter, but have never found crystals in cream.

When butter is freed from water and salt by melting at a low temperature, and then dissolved in chloroform and crystallized by the fourth method, several forms are observed, the most usual of which are given in Figs. I, and II.*

Crystals like Fig. I, having a diameter of $\frac{1}{80}$ to $\frac{1}{100}$ inch, are very abundant. They consist of fine silky filaments radiating from a center, the field presenting a somewhat wavy appearance, well shown in the figure. Viewed by polarized light the bright crystal on a dark ground appears marked by a cross, as shown under tallow. Fig. II shows another interesting form. We have here a portion resembling Fig. I joined to, or extending into a plate-like bundle of needles similar to some mentioned below.

* The cuts were made from micro-photographs by the photo-engraving process, with two exceptions. The bees-wax plate and that by polarized light were made from drawings.

In some cases these needles lie so close together as to be undistinguishable from plates, with ordinary powers, and are similar to the common plates of lard or mutton tallow.

Fig. III bears a striking resemblance to Fig. I. The crystals represented here were obtained from pure stearin, by crystallizing it at a very low temperature. On allowing a drop of the chloroform solution, on a slide, to remain over night, the field was found, when examined in the morning, to be thickly covered with the forms here shown.

Nothing else could be seen, and these disappeared on the application of a slight degree of warmth. So delicate are they that I made several attempts to photograph them before succeeding, and then only after removing my instruments to a cold room. It is possible the butter crystals may have a similar composition. Other forms observed will be referred to below.

BUTTERINE.

Samples of butterine, as now found in the market, show a large number of forms when crystallized from chloroform solution. I have observed forms very closely resembling Figs. IV, VII, XV and XVI. We have here a complex body, and the proportions of the several fats used are, without doubt, of great influence on the manner of crystallization. I wish to reserve the subject of butterine crystals for a fuller discussion at a future time, and hence, will not enter into details here.

MUTTON TALLOW.

Mutton tallow and others to follow consist almost entirely of the glycerides of palmitic, stearic and oleic acids, that is of acids of large molecular weight, which are not readily volatile without decomposition. Butter fat differs from these substances in this, that it contains 8 to 10 per cent. of glycerides of volatile acids. There is necessarily a marked physical difference between butter and other fats, and we should expect corresponding differences to appear in the microscopic forms. Figs. IV, V, VI, VII, VIII and IX give the chief forms found in mutton fat. All of these crystals can be found on one slide, and frequently two or three in the same field. It is not easy to say which is the most characteristic or numerous. Nos. IV, V and VI are readily produced, and are, in a certain sense, primary forms. They are among the first which become clearly defined on the evaporation of the chloroform, and are very stable, remaining many months, perhaps years, in perfect shape. Nos. VII, VIII and IX are peculiar. Crystals separate from chloroform solutions of mutton fat very quickly, some forming within a few minutes, while others separate out after a longer time. Very soon a field is found which consists of well defined rhomboidal plates, Fig. VII, which differ from Fig. IV in this,

that they are shorter, and, as will be seen, less stable. If one watches them carefully, he will find them undergoing a change by splitting in the direction of their greatest lengths into bundles of needles. Soon these diverge from each other at the ends, giving the appearances well shown in Figs. VIII and IX. The divergence is often greater than here shown.

I have followed these changes very closely with the microscope, and in one instance made photographs of two fields to show this.

Fig. VIII is, in fact, an enlarged portion of the crystals of Fig. VII, and was taken four hours later. This change of rhomboidal plates like Fig. VII, to bunches of divergent needles, as shown in VIII and IX, is somewhat characteristic of mutton tallow. Growth and change of crystals can be observed in nearly all fats, but this peculiar change I have not noticed elsewhere.

BEEF TALLOW.

Very fine crystals can be obtained from this substance, but the variety is probably not as great as in the case of mutton fat. The more usual forms are represented in Figs. X, XI, XII and XIII. Very frequently I have observed crystals which differ from X only in this, that the needles terminate without crossing at the center. Figs. XI, XII and XIII are well represented. The last named is one of the commoner forms found in the fat of the dog. In Fig. XI the nucleus is not quite in the center, but I have found in tallow many crystals in which it is in the center, and when such are viewed by polarized light we obtain the effect well given in Fig. XIV, the cross being exactly similar to that referred to under butter. I have occasionally found in pure tallow masses of crystals similar to those of Fig. IV. These are more frequently found when the tallow is mixed with a small amount of fatty oil.

LARD.

Lard differs, qualitatively, very little from beef or mutton tallow, but quantitatively, it is characterized by a larger amount of olein. The microscopic forms are not numerous. Figs. XV and XVI show those most commonly seen. The rhomboidal plates of XV are usually sharply defined and transparent, as they are very thin. They resemble closely the plates found in mutton tallow. In Fig. XVI we have a combination of an imperfect plate with a plumose tuft, somewhat similar to a form found in butter, but not quite the same. Another form seems to consist of very small plates which have undergone a partial change by sending out spines as in some of the mutton tallow crystals. The spines are, however, very short and sharp. It is possible that Fig. XVI grew in a somewhat similar manner. A change, in some degree analogous to this, may be observed by crystallizing beeswax from chloroform. The plates which first form are equilateral rhomboids, but after a time these change in a very remark-

able manner. The points farthest apart become blunt, and send out little spicules. These grow by curving outward until the dumb-bell of Fig. XVII is reached. The first and intermediate forms are also shown in XVII, and the process of change can be readily followed by the microscope.

In mixtures of lard and tallow numerous plates resembling XV can be found, and, in general, everything found in each, provided proper proportions be taken. When equal parts of the two fats are mixed the crystals formed are frequently of the types shown in Figs. XVIII and XIX. Fig. XVIII is very characteristic, consisting of plates expanded at one end into tufts of curved needles. In Fig. XIX we have a number of over-lying plates, the ends of which have grown into tufts. By varying the proportions, very different results can be obtained. When the tallow is largely in excess a very common form is produced, shown in Fig. XX. This form polarizes as XIV. Needles form much more readily than plates.

HUMAN FAT.

In examining the fats above mentioned I took for solution portions representing the average composition of the whole substance. Melted human fat readily separates on cooling, into two layers, a liquid, and a semi-solid mass. For my tests I worked with the latter, which had the consistency of lard.

Two forms are readily found on microscopic examination, and beyond these not much more. These are well shown in Figs. XXI and XXII, of which those like XXI predominate. Sometimes the very fine needles radiate from the center in all directions, and without curvature.

DOG FAT.

The fat of the dog crystallizes from chloroform solution in fine wavy needles, radiating from a center. Fig. XXIII shows a very common appearance. Other forms are similar to fine crystals of butter shown in Fig. I, and to the tallow-lard mixture of Fig. XX. The cross by polarized light is perfectly exhibited.

CAT FAT.

Fig. XXIV shows a form of crystal readily obtained from solutions of cat fat. Other forms consist of imperfectly shaped plates observed in mutton and butter.

It will be observed that butter fat and the last three described have this in common. Their ordinary mode of crystallization is in exceedingly fine lines or needles radiating from a nucleus. The lines of lard, beef-tallow, or mutton-tallow, are not as fine or feathery as those just mentioned. Butter and the other fats resemble each other, even when very

fresh, in having a strong and characteristic odor, showing the presence of relatively large amounts of volatile substances. These volatile matters are doubtless glycerides of lighter acids, and the addition of a small amount of such substance makes a change in the appearance of the crystals, as I have found by adding a little artificially prepared glycerine butyrate to some mutton tallow.

OTHER FATS.

In his classic study of the composition of fats Berthelot prepared a number of them artificially, by heating mixtures of glycerine and the fatty acids. (*J. B.*, 1853, p. 451.)

By heating equal weights of glycerine and stearic acid in a sealed glass tube to a temperature of 200°C. for 26 hours, he obtained, after eliminating the uncombined acid and glycerine, mono-stearin. In like manner he prepared di-stearin and tri-stearin, and the glycerides of other acids.

Soon after this Heintz went through the same processes, obtaining like results. (*J. B.*, 1854, p. 447). According to the process proposed by Berthelot, I have prepared several of the fats, and studied their crystalline forms. The results have not been altogether satisfactory, or just what I anticipated. There are many difficulties in the way of purifying some of the products when prepared, but until this is done I think we cannot expect to reach a fair explanation of the many forms observed in these crystallizing bodies.

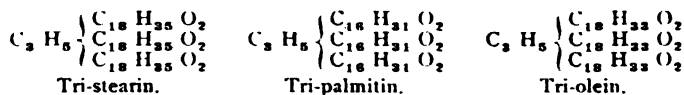
Several hypotheses may be presented to account for the numerous modes of crystalline aggregation observed in the photographs I have made, but it must be admitted that no one of them amounts to a satisfactory explanation. It is usually held that the ordinary phenomena of di- and tri-morphism, observed among mineral crystals, are brought about by variations of temperature at time of crystallization. It is also known that several simple substances of perfectly definite composition crystallize in different forms from different solvents.

Among the simpler fatty bodies I have noticed a remarkable variety of forms in samples of pure stearic acid, prepared by fractional precipitation, and in pure stearin.

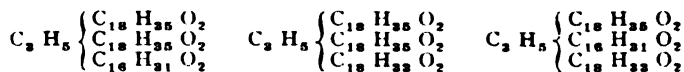
If we assume that these samples were not absolutely pure, which is of course probable, there comes up another hypothesis worthy of consideration. Williamson, in advancing his theory of etherification (*Chem. Soc. Quar. Jour.*, IV, 229), and Clausius in discussing certain phenomena of electrolysis (*Pogg.*, CI, 338), proposed an explanation of the nature of solutions, which has been of great assistance in the study of many reactions. They held that the component parts of a molecule in solution can not be considered as firmly linked to each other, but as continually moving about, exchanging places with corresponding parts of other molecules.

KCl and Na NO₃ in solution form some Na Cl and K NO₃, so that at any one time we may consider four substances present, instead of two. This hypothesis may be extended to molecules of greater complexity.

Referring to the formulas on page (74), we see that we have in most natural fats three groups:



In solutions, more could be formed from these, as:

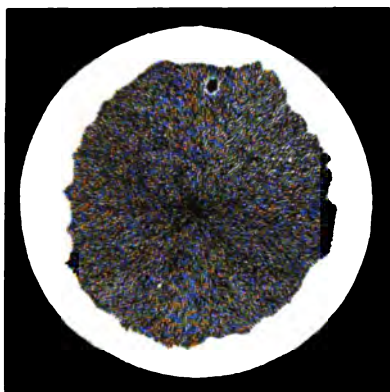


If we consider a fourth or a fifth fat present, as in the case of butter, a much greater number of combinations would be possible, and I think it probable that at the time of crystallization some of these secondary forms would separate out, just what ones, depending, of course, on conditions of temperature and concentration. At one instant the conditions may be right for the formation of one nucleus, and at the next for the formation of another.

While many combinations are possible, a few are more probable because of their stability; just as in the cases of isomers among alcohols and hydrocarbons.

I believe that by working at lower temperatures, I could have obtained an even greater variety of crystalline aggregates than indicated above, as was indeed suggested by my experience with stearin. These considerations lead me to think that the microscopic identification of mixtures of fats is a problem of much greater difficulty than might appear at first sight. I think ultimately a great deal may be accomplished in this direction, but until the various effects of temperature and percentage composition are understood; until they have been demonstrated by actual experiment, I think it unwise to lay very great stress on results obtained in this way.

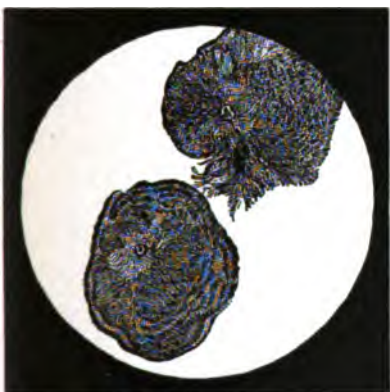
CHICAGO MEDICAL COLLEGE, January, 1885.



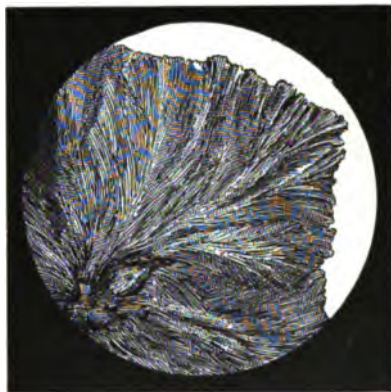
I.



II.



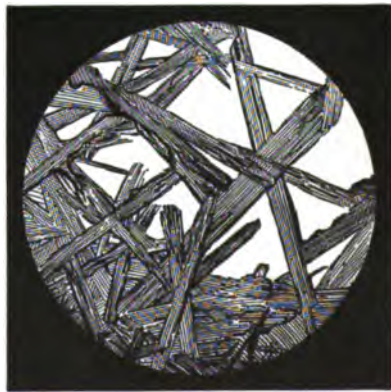
III.



IV.



V.



VI.





VII.



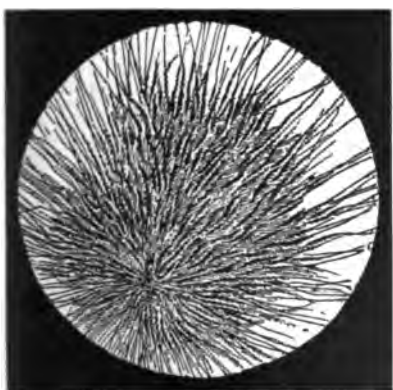
VIII.



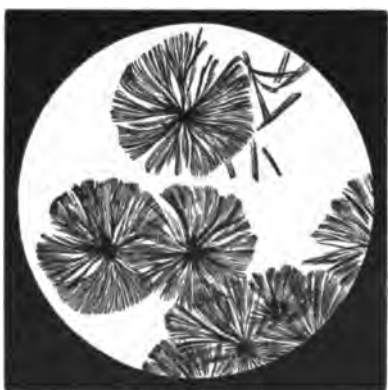
IX.



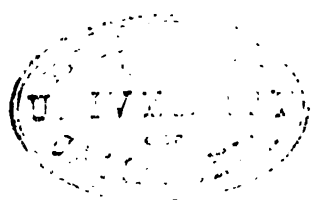
X.

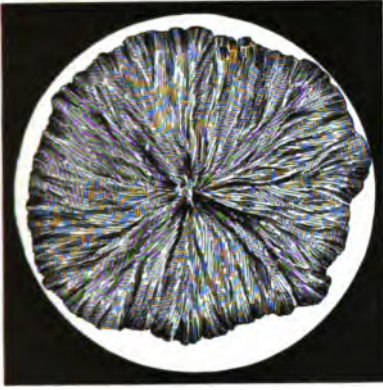


XI.

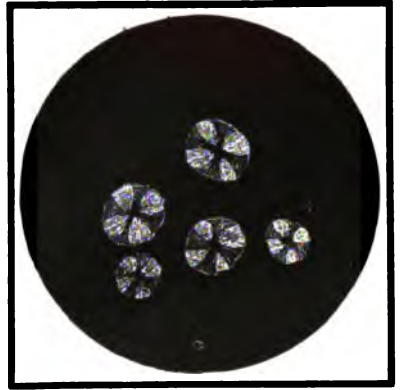


XII.





XIII.



XIV.



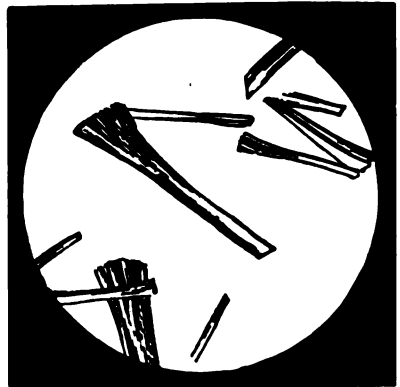
XV.



XVI.



XVII.

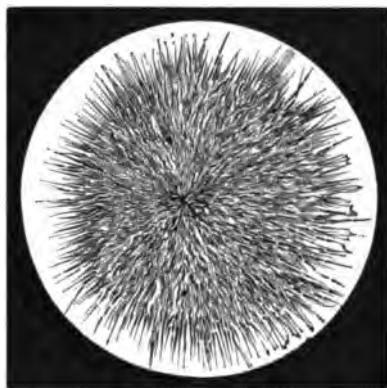


XVIII.





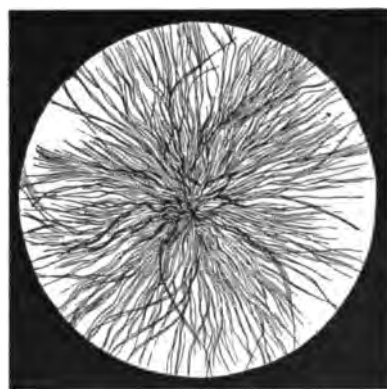
XIX.



XX.



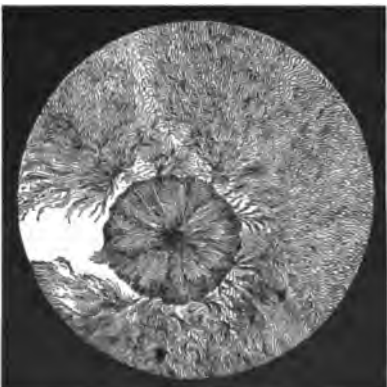
XXI.



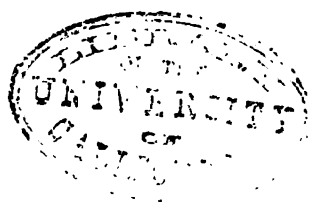
XXII.



XXIII.



XXIV.



Vol. I.

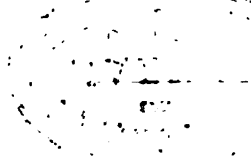
No. VIII.

BULLETIN
OF THE
Chicago Academy of Sciences.

CHICAGO ARTESIAN WELLS.

ON THEIR STRUCTURE AND SOURCES OF SUPPLY.

BY LEANDER STONE, A. M.



READ BY THE AUTHOR BEFORE THE CHICAGO ACADEMY OF SCIENCES,
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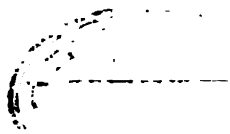
OF THE

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THE

ARTESIAN WELLS OF CHICAGO.

By LEANDER STONE, A. M.



CHICAGO:
PRINTED FOR THE ACADEMY.



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THE ARTESIAN WELLS OF CHICAGO.

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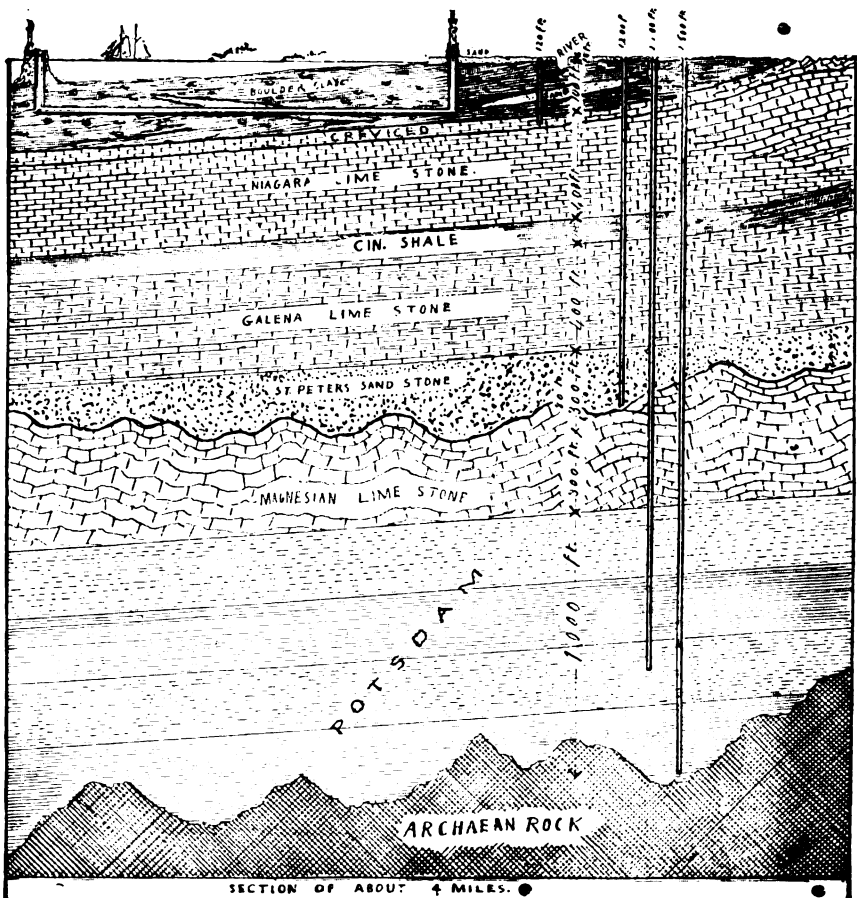
The water supply of Chicago is one of the most important subjects that can engage the attention of its citizens. The lake is the most natural source; but the fact that the greater part of the sewage flows into it, particularly at certain periods of the year, makes the subject of a pure water supply quite difficult.

Something like twenty years ago the first artesian well at the Union Stock Yards was bored, the depth being about 1,200 feet. The flow of water was free and large. A little earlier a well was sunk in the north-west part of the city called "*The Artesian Well*," because it was the first in the city. The object sought was oil, not water; but at the depth of something like 1,200 feet a good supply of water was obtained. Before the fire a considerable number of artesian wells had been made, all of which, I believe, overflowed and gave a very free supply. After the fire a new impetus was given to the business. Wells were bored in a number of places in the heart of the city—at the corner of State and Washington streets, at the Palmer House, at J. V. Farwell's wholesale house on Franklin and Monroe streets, at the Singer building and at other points. Every large packing house in the region of the Stock Yards has one or more artesian wells. There are nineteen in this region alone, yielding each day of ten hours 1,065,000 gallons. Nearly or quite all these wells are pumped to their full capacity, and so made to yield a much larger supply than would be obtained through the natural overflow.

At the parks are several wells—on the West Side, five; Lincoln park, two; South park, one. Nearly or quite all of the distilleries and malt houses have wells, and the total number in the city and immediate suburbs must be nearly or quite eighty. If the ratio of yield were the same in all as at the Stock Yards the total amount of water raised each day

would be about 4,500,000 gallons; but the ratio is much less and an estimate of 3,000,000 gallons each day would be much nearer the truth.

The rocky strata which underlie Chicago, it is well known, are substantially like those of eastern Wisconsin and dip to the east or south-east, rising to the surface at various points at a distance west of lake Michigan. They form the lowest group of distinctly fossiliferous deposits, and are commonly known as the silurian. From the products of the drill in excavating the shafts through these layers, as well as from the out-cropping, it is known that next below the boulder or drift clay lies the Niagara limestone, which is followed in order by the Cincinnati shales, the Galena and Trenton limestones, the St. Peter's sandstone, the lower magnesian limestone, the Potsdam sandstone and the Archaean or Crystalline rocks. The following is a general representation of the proportional thickness of each:



It will be seen that there are in Chicago four different classes of wells, according to the depth. First, there is a considerable number which go no further than just through the clay and into the superficial layers of the Niagara limestone. There are perhaps twenty of these wells, in all of which, with one exception, the water stands at a level not far from that of lake Michigan.

Second, There is a large number which reach down to 1,200 or 1,250 feet and end in or near the St. Peter's sandstone. Nearly all the wells sunk soon after the great fire, and for several years before, were put down to this level and yielded good supplies, which overflowed with various degrees of force and copiousness. It was soon discovered, however, that as the number of wells sunk to this depth increased the flow of those already made decreased, until some ceased to overflow altogether. The well at Central, now Garfield Park, at first rose to a height of forty feet, and yielded forty-three gallons per minute. The supply grew less as new wells were made, until the Park Commissioners tried an experiment to prove whether the supply was common to all the wells. At their request all the wells in the city, with one or two exceptions, were closed for several hours, when it was discovered that the water rose to a considerable greater height than usual in all the wells. This was regarded as conclusive evidence that they were fed by a common reservoir, and also that the water quite freely flowed from one to another. From the time that it became evident that the supply from the old wells would certainly be diminished by every new well, the well-makers turned their attention to ascertaining whether a lower stratum of water-bearing rock could not be found which would yield a supply unaffected by the upper.

New wells were put down to 2,000 and even 2,200 feet, when a supply was found equal or superior to that in the St. Peter's sandstone. This forms the third class of wells.

The fourth class is deeper, and in one case reaches the depth of 2,604 feet, or within thirty-six feet of half a mile. One general fact seems to be borne out by the analysis of the various wells, that the deeper the wells the greater the amount of solid mineral matter. The Lehman well, near the corner of Diversey avenue and N. Clark street, is said to be the deepest artesian well in the State, and the deepest flowing well in the United States. It is 2,604 feet and six inches in depth, and contains in each gallon of water over 322 grains of solid mineral matter, or more than one-half of one per cent. Two hundred gallons of water evaporated, would leave more than a gallon of solid sediment, much more than half of which would be common salt.

Most, or perhaps all, of the wells 1,200 feet deep contain too much lime to permit of the water being used in making steam. The well of Mr. Lehman doubtless extends nearly to the archæan rocks, as represented in

the diagram. I am indebted to the kindness of the Hon. Wm. Bross for procuring for me from the contractors, Gray Brothers, Milwaukee, carefully recorded sections of four wells along the lake shore north of the city. A comparison of the four, one of which is owned by Mr. Bross (the Winnetka well) will afford some interesting statistics. In order that they may be more readily considered I group them together :

	Lake Bluff.	Winnetka.	South Evanston.	Rogers Park.
Clay.....	207	184	74	72
Limestone.....	320	316	316	308
Shale.....	198	192	174	185
Limestone	216	247	228	238
St Peter's sandstone.....	167	212	458	317
Red marl.....	32	45	12	...
Limestone.....	46	114	84	...
Potsdam sandstone.....	...	356	274	...
Total depth.....	1186	1666	1620	1120

The table is such that read from left to right the order is south and towards Chicago. The Lake Bluff well is something like thirty miles from that of Rogers Park. The Niagara limestone, the Cincinnati shale and Trenton limestone, it will be seen, are quite uniform in thickness. The St. Peter's sandstone shows a great thickening at Rogers' Park and South Evanston, while next below it is a peculiar bed called red marl, which seems to begin somewhere north of Lake Bluff, reaching its maximum depth at Winnetka and thins out at South Evanston, and between that and Rogers Park disappears. This red marl, lying next below the St. Peter's sandstone, is the equivalent of an easily broken unhomogeneous rock which is quite uniformly found in the Chicago well shafts. It seems to be neither sand nor lime, more or less fragmentary and easily crumbled. Mr. Stanford, ex-President of the West Park board, says that in sinking the Garfield Park well to a lower depth this rock was so easily broken down that a cavity of something like a barrel in size was formed before the drill began to perforate the more solid rock below.

In addition to the above classes of wells, it should be said that in the northwestern part of the city, in the vicinity of the old toll gate on Milwaukee avenue, there are several wells yielding a good supply of water at a depth of only about 800 feet. These are all within a half a mile of each other, and I have not learned of any others in the city. The vein appears to be local, and is not met with anywhere else.

The source of the water supply for the lower water-bearing rocks is easily accounted for, since all the lower strata rise to the surface at successive distances west and northwest of lake Michigan, and at altitudes which would give a pressure sufficient to force the water to and above the

surface of the highest bluffs on the coast. In Wisconsin wells have been bored at Sheboygan, Milwaukee, Racine and Kenosha, and the strata, which are water-bearing at a depth of many hundred feet on the coast, crop out in the interior—those at Sheboygan, at Green Lake; those at Milwaukee, at or near Beaver Dam; those at Racine, at Janesville, and those at Kenosha, at the Rock river. These inland points are each enough higher than the surface at the lake to cause an overflow at the lake shore; and artesian wells at points west from the shore grow less in depth as they are distant from the lake. The shallow wells at Oshkosh vary in depth, according to Prof. Chamberlin, and are from 15 to 100 feet.

The wells of Chicago, which pass through the blue clay and "hard pan" into the upper layer of the Niagara limestone, and stop there, have caused some debate as to the source of supply. In these wells, as a rule, the water rises to a point not far from the level of the lake, and thus the opinion has been formed that they are fed from the lake, which backs up through the crevices in the limestone. As the rock is exposed under the water of the lake at various points, such an opinion appears plausible. A careful consideration of the facts only will enable us to form a correct opinion.

The first of these wells was that of Mr. W. F. Bloom, which was made a short time before the great fire. It is situated at the corner of Thirty-fifth and Bloom streets. Mr. Bloom began to dig in the clay in the old-fashioned way, with pick and spade, for water. After he had gone forty feet he came upon the solid rock or hard pan. He then began to drill a shaft $1\frac{1}{2}$ inches in diameter. After passing through two feet of hard pan, two feet of shale and about three feet of limestone the drill dropped a few inches, and a copious supply of water was the result. The water passing up through this small aperture quickly filled the well, some five feet in diameter. Mr. Bloom made a persistent effort to pump the water out, using a common suction pump and a chain pump, and failed to make an impression on the volume of water. He filled the well up to within a few feet of the top with broken bricks and stone, and then made a curb about it. The water is sweet and pure and has never failed, although it has been freely used by the neighbors for many years. It has been supposed that the water stands at a level with the lake and rises and falls with the lake-level.

Some time later Mr. A. S. Piper sunk a similar well a short distance from Mr. Bloom's, at the corner of Ashland avenue and Twenty-seventh street. This well-shaft passes through fifty-six feet of clay and fourteen and one-half feet of rock. The diameter is three inches. A fire engine was employed for some time in a vain effort to exhaust it. It is used to supply a horse barn and about forty horses. The water is pure and good, but I have no analysis.

Mr. F. S. Swalley has constructed a large number of these wells with a bore of six inches through the clay and five inches in the rock. Messrs. Libby, McNeil & Libby, packers, have two wells near Sixteenth and State streets, within about eight feet of each other. The pumping of one does not seem to affect the supply of the other. The wells pass through about ten feet of sand, fifty-five of clay and hard pan, and end thirteen feet in the rock. The water is thoroughly impregnated with iron and sulphur, and cannot be used in steam boilers. The engineer reports that he has several times lighted the gas which rises through the water in the morning after the wells have remained unused through the night. The supply is about forty gallons a minute. There is another of these wells at Twenty-seventh street and the lake, owned by the U. S. Distilling Company. It passes through twenty-seven feet of sand, thirty feet of clay, ten feet of hard pan and thirteen feet of rock. The supply is very small, only about twelve gallons per minute.

Mr. Chas. Pope has one for his malt house at 488 North State street. It is about three hundred feet from lake Michigan, and the water is almost exactly like pure lake water. The Huck Malting Company, corner of Canalport avenue and Eighteenth street, has a well from which the water at one time flowed over the top at a level of about eight feet above the river. It is the only one of the shallow wells that overflows. The shaft passes through ten feet of alluvium, sixty feet of clay, five feet of boulders and hard pan and several feet into the rock. The well yields about forty-five gallons per minute.

Near the corner of Market and Erie streets, on the North Side, is another of these wells, which, after reaching the requisite depth in the rock, about fifteen feet, had to be pumped out completely several times before the water flowed into it freely. The pumping seems to have freed the well from clay which clogged the openings in the rock at the base of the bore.

The wells of the class constructed at Goose Island, on the north branch, are much impregnated with lime and sulphur, and the water cannot be used in steam boilers. One of the finest wells of this class is at Mr. Jennings' laundry, at 405 West Madison street. It passes through ninety feet of clay, six feet of hard pan and fourteen feet of rock—a gray limestone. The water is perfectly soft and pure—softer than lake water. It is used by the proprietor for washing purposes, for which it is much better adapted than the lake water, and the water is sought by many of the neighbors and used in preference to that from the hydrants for drinking and culinary purposes. I asked Mr. Artingstall, the city engineer, if he would not mark a bench at this well, giving the altitude above the city datum, and he very kindly deputized a surveyor to run a level to the well. The mark of the surveyor is 17.454 feet above the lake. This mark is

6.25 feet above the concrete floor where the tube of the well terminates. I was unable to measure the height of the water in the well owing to the fact that it is inaccessible by reason of the pumping machinery; but the foreman said the level of the water when the well was completed, stood about twelve feet from the surface, which would be less than a foot from the lake level. The Jennings well is a prize worth far more than it cost. It seems to have an unlimited supply of water. The deepest of the wells sunk by Mr. Swalley was near the crossing of Larrabee street and North avenue. Here was tried a suggestive experiment. Usually the drill is stopped after reaching from twelve to twenty feet within the Niagara limestone. In this well water was reached at twenty feet, but the flow was only moderate—about nineteen gallons—and to see if it could be increased the drill was sunk seventy feet further, but without augmenting in the least the flow. This experiment seems to prove that the water-bearing rock is superficial and does not exceed about twenty feet. This contractor has put down something over twenty of these wells. Some have failed to yield a sufficient supply to be of any utility—twelve gallons per minute being regarded as the practical minimum. In one case a sand pocket was found in the clay in a boring made near the intersection of Carroll avenue and Ada street, which was not exhausted except by vigorous steam pumping for eight to ten hours. Usually in passing through the clay water had to be supplied to the drill by pouring in at the top. The temperature in all these wells, winter and summer, ranges from 50 to 55 Fahrenheit.

The source of supply for these shallow wells is not altogether easy to settle. The fact that the water stands in them at or very near the level of the lake has given rise to a general belief that the rocks from which the water is derived afford communication by connecting fissures with the water of lake Michigan. It seems, however, that the levels of these wells are not uniform. One overflows at an elevation of eight feet above the lake and others vary more or less. Besides, the quality of the water differs through varying degrees. The water of the well at 405 Madison street is said to be purer and freer from lime than the lake water; while most are too much impregnated with lime or iron to be used for making steam. It is quite certain that the water is affected by the rock which is in close contiguity to the several wells. The diversity of the water seems to afford strong presumptive evidence that the supply is local and not broad and general.

There are various more or less wide areas within and near the city where the Niagara limestone comes to the surface, or so near it as to receive the rain which sinks into the crevices and cracks, which are more numerous in the top layers than in the deeper measures. At Archer avenue and Twenty-fourth street, at Eighteenth and Lincoln streets, in the northwestern portion of the city, and a little further west in Cicero, are

quite wide areas, where the rain falls upon the fissured rocks and sinks into it, and ultimately finds its way below the clay, where the drill of the well-borer meets it. At the quarry of Dolese & Sheppard, in Cicero, south of the Burlington & Quincy railroad, the miners' families get water from wells drilled in the limestone to a depth of thirty feet. Water to the amount of from twenty to thirty pails a day can be procured from these wells in all but the driest times. The water percolates through the rock and into the wells, and, in this case, these wells are not more than twenty or thirty rods from the quarry. As an indication of the amount of water which these exposed rocks carry below the clay, it may be mentioned that on August 2d, when something over five inches of rain fell within twenty-four hours, the steam pump at the Eighteenth street quarry was operated all day Sunday, all of Sunday night and until Monday noon before the quarrymen could work. This engine has a cylinder of ten inches stroke and eight inches in diameter, with sixty strokes a minute. This would raise about 172,000 gallons in twenty-four hours. In a year there is a total rain fall in this country of about forty inches, which would give eight times as much water to carry off in the twelve months. The upheaval which throws up the rocks to the surface where these quarries are, reaches the Desplaines at Lyons, as Dr. Henry M. Barrister reports in the Illinois Geological Survey. This gives a wide area for rain-fall, and would seem to afford a good supply for all the wells yet sunk or likely to be sunk. The conditions seem to be quite similar to those at Oshkosh, Wis., where artesian wells of three kinds are put down, and afford that city its supply of water. The first are sunk to the drift clay and beneath the surface red clay, the depth being about twenty feet; the second are put down through the blue clay to what Prof. Chamberlin calls the concrete, which consists of partially cemented sand and gravel, and lies immediately on the Niagara limestone. The third class is nearly like the shallow artesian wells of Chicago. Prof. Chamberlin says the flow originates in the rock, within from six to twenty feet of the surface. These wells do not overflow, but the water rises nearly to the surface of the ground, and perhaps a foot or two above the waters of lake Winnebago. Prof. Chamberlin thinks the source of supply is to the westward, and less than ten miles distant.

The question of the water supply in the shallow artesian wells is complicated by the fact that frequently sand pockets of large area, filled with gravel, sand and water, are met with imbedded in the boulder drift clay. A few years ago, when the city authorities were constructing a tunnel beneath the north branch, at Division street, for the water mains, at a depth of nineteen feet below city datum, and several feet below the bed of the river, a sand pocket, of dimensions so large as to make the word pocket a misnomer, was found. It was more like a broad stratum. The water rose in the shaft a foot or two above the level of the river, and this was the fact

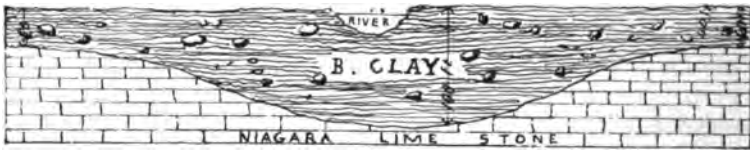
which enabled the city engineer to assume that it was not river water. Two powerful steam pumps, raising together 350 gallons per minute, were set to work, and were kept busy about two days before the water was exhausted, when, at length, it was all removed, and no further trouble experienced; but in the meantime, the docks for several feet on both banks of the river perceptibly settled, and old wells, which had always yielded water since their construction, were discovered to be dry, and persons living half a mile from the river, to the west, inquired what had been done to drain their wells. The shaft was sunk about seventy-five or eighty feet from the river. Similar trouble was met with when the excavation was made for the pumping engines at Ashland avenue and the south branch, which seems to indicate that the river has something to do with supplying the water.

It appears that the lower sand and limestone measures are formed of alternate solid and impervious layers, and broken and cracked strata. In deepening the well at Garfield Park, a few years ago, the contractor came across a layer of rock which seemed too brittle for the drill to pass through until a large cavity had been broken down and removed. The contractor of the new well recently finished for the West Park Commissioners, in the angle of the boulevard leading from Douglass Park to Garfield Park, says that at a depth of 1,148 feet the drill reached a seam about five feet across. The drill dropped that distance before touching solid rock again. In the meantime the water in the well, which had been overflowing, ceased entirely to reach the surface, and sunk to a level of about three feet from the top, and remained there until the seam was completely shut off by tubing. This well was sunk to a level of 2,317 feet. It contains $196\frac{1}{2}$ grains of solid matter in each gallon of water, more than half of which, or $134\frac{1}{2}$ grains, is common salt. This large seam, and the fact that it caused the overflow to cease for six weeks, or until the water at the seam could be shut off by tubing, is a curious fact.

The boring of so many wells in the city has made it comparatively easy to determine the topography of the surface, were the overlying mass of clay and drift entirely removed. It may be said in general that the Chicago river would flow nearly where it does now if the clay were entirely removed. In other words, the main river and two branches lie over depressions in the Niagara limestone corresponding to the river. The deepest clay is under and on both sides of the river, north and south, and along the branches. In the path of the main river, and for a distance of several squares, either side, it is 100 feet deep and over in some places. At Indiana street and the north branch it is 135 feet deep, and further up the river it ranges from 60 to 70 feet in depth. At Twenty-second street and Canalport avenue it is 100 feet deep; at Eighteenth street it is 70 feet deep. Between the south branch and the lake, at Libby, McNeil &

Libby's packing house, on State street and Sixteenth, the clay is 55 feet thick, and at the Consumer's Gas Company's well, at Twenty-fifth and Hanover streets, it is 37 feet thick. At 405 W. Madison street it is 90 feet thick. Were the drift wholly removed from the underlying limestone, and the water of lake Michigan kept from flowing in, the surface would be no longer a plane. A rocky knoll over 100 feet in height would appear at Milwaukee avenue and the old Toll Gate, having quite a wide area at top.

The following section across the main river will give a notion of the depth of clay.



Similar high elevations would appear at Eighteenth and Roby streets and at Twenty-fourth street and Archer avenue, while a ridge of rock would extend westward to the Desplaines and Lyons. At Van Buren street, on the South Side, there would be an ascent of sixty feet to a rocky upland at Sixteenth street, extending southward. These ridges are upheavals, as shown by the dip of the strata in general, coinciding with the slant of the surface, as at Archer avenue, Eighteenth street and Cicero quarries, and particularly the rocky ridge of Stony Island, near South Chicago. These elevations were in existence when the drift clay was laid down, as is shown by the planed-off surface of Stony Island, and the fact that the rock thus removed by glacial action is found in the tough clay which is deposited as a tail to this crag in a southwestern direction.

In conclusion, the facts seem to show that the water in the shallowest artesian wells has its source in the limestone outcroppings about and within the city, and partakes of the qualities of the rocks through which it passes in a pretty direct line from the outcropping to the lowest portions of the Niagara limestone. In some cases, as at 405 W. Madison street, the channel is a bed of sand and gravel, and the water is, therefore, very soft and pure. In others, as at the wells at Sixteenth and State streets, where there is iron and inflammable gas, the water doubtless passes through a rock rich in the products of organic remains. The overlying clay rests firmly and everywhere upon the rock and fills the superficial cavities for several feet.

Vol. I.

No. IX.

BULLETIN

OF THE

CHICAGO ACADEMY OF SCIENCE.

ON RHIZOCARPS

IN THE

ERIAN (DEVONIAN) PERIOD IN AMERICA.



BY SIR WILLIAM DAWSON, LL.D., F.R.S.

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BY SIR WILLIAM DAWSON, LL.D., F.R.S.

(READ BEFORE THE ACADEMY, MAY 11, 1886.)

The motive of the present paper is to notice certain specimens of the organs of fructification of cryptogams obtained from the Erian shales of Canada and Ohio, and from shale boulders in the Chicago boulder clay, and from the clay itself, and which have been prepared for microscopic examination by Mr. B. W. Thomas, F. R. M. S. of Chicago. I have, however, thought it best to sum up the present state of our knowledge of the subject, in connection with the descriptions of the new specimens recently studied. The subject may thus be treated under the following heads:

1. Recapitulation of the progress of discovery in relation to Sporangites and their allies.
2. Description of specimens recently studied.
3. Mode of occurrence of the specimens in relation to their origin.
4. Classification and description of species.
5. General remarks.

I.—RECAPITULATION.

My attention was first directed to the organisms referred to in this paper by the late Sir W. E. Logan in 1869. He had obtained from the Upper Erian Shale of Kettle Point, Lake Huron, specimens filled with minute circular discs to which he referred, in his report of 1863, as "microscopic orbicular bodies." Recognizing them to be macrospores, or spore-cases, I introduced them into the report on the Erian Flora which I was then preparing, and which was published in 1871, under the name *Sporangites Huronensis*.

In 1871, having occasion to write a communication to the American Journal of Science on the question then raised as to the share of spores and spore-cases in the accumulation of coal, these curious little bodies were again reviewed and were described in substance as follows:

"The oldest bed of spore-cases known to me is that at Kettle Point, Lake Huron. It is a bed of brown bituminous shale, burning with much flame, and under a lens is seen to be studded with flattened disc-like bodies, scarcely more than a hundredth of an inch in diameter, which under the microscope are found to be spore-cases (or macrospores) slightly papillate externally, (or more properly marked with dark pores,) and sometimes showing a point of attachment on one side and a slit more or less elongated and gaping on the other. When slices of the rock are made, its substance is seen to be filled with these bodies, which, viewed as transparent objects, appear yellow like amber, and show little structure, except that the walls can be distinguished from the internal cavity, which may sometimes be seen to enclose patches of granular matter. In the shale containing them, are also vast numbers of rounded, translucent granules, which may be escaped spores (microspores)."

The bed containing these spores at Kettle Point was stated in the reports of the Geological Survey of Canada, to be 12 to 14 feet in thickness, and besides these specimens it contained fossil plants referable to the species *Calamites inornatus* and *Lepidodendron primaevum*, and I not unnaturally supposed that the *Sporangites* might be the fruit of the latter plant. I also noticed their resemblance to the spore-cases of *L. corrugatum* of the lower Carboniferous, (a *Lepidodendron* allied to *L. primaevum*,) and to those from Brazil described by Carruthers under the name *Flemingites*, as well as to those described by Huxley from certain English coals, and to those of the Tasmanite or white coal of Australia. The bed at Kettle Point is shown to be marine by its holding *Spirophyton*, and shells of *Lingula*.

The subject did not again come under my notice till 1882, when Prof. Orton of Columbus, Ohio, sent me some specimens from the Erian shales of that state which on comparison seemed undistinguishable from *Sporangites Huronensis*. These shales have been described as to their Chemical and Geological relations, by Dr. T. Sterry Hunt, *Am. Journal of Science*, 1863, and by Dr. Newberry, in the Reports of the Geological Survey of Ohio, vol. I, 1863, and vol. III, 1878.

Prof. Orton read an interesting paper on these bodies, at the meeting of the American Association in Montreal, in which were some new and striking facts. One of these was the occurrence of such bodies throughout the black shales of Ohio, extending "from the Huron River on the shore of Lake Erie to the mouth of the Scioto in the Ohio valley, with an extent varying from ten to twenty miles in breadth," and estimated to be 350 feet in thickness.* Another was the absence of any traces of

*In a letter, received since the reading of this paper, Prof. Orton states that "borings in the Ohio black shale have penetrated it to a depth of 1800 feet without reaching the bottom." So that its whole thickness is probably much greater than stated in the text. Specimens of these borings kindly sent to me by Prof. Orton, are well filled with sporangites throughout the thickness of the shale as far as penetrated.
—B. W. T.

Lepidodendroid cones, and the occurrence of filamentous vegetable matter, to which the *Sporangites* seemed to be in some cases attached in groups. Prof. Orton also noticed the absence of the trigonal form, which belongs to the spores of many *Lepidodendra*, though this is not a constant character.* In the discussion on Prof. Orton's paper, I admitted that the facts detailed by him shook my previous belief of the lycopodiaceous character of these bodies, and induced me to suspect, with Prof. Orton, that they might have belonged to some group of aquatic plants lower than the Lycopods.

In the same discussion, Prof. Williams, of Cornell University, mentioned that he had found similar bodies in the Hamilton shales of New York, and that they were associated with the curious pinnately leaved plant *Ptilophyton vanuxemii*, an observation to which I subsequently referred in discussing the affinities of this fossil, in a report on the Erian plants of Canada, published in 1882.† Prof. Williams was kind enough to send me specimens, in which, however, the round spore-case-like bodies were much less distinct than in the specimens from Ohio and Lake Huron. In the report above referred to I have also noticed the occurrence of rounded spore-like bodies in association with the stems of *Trochophyllum* of Lesquereux from the lower carboniferous of Pennsylvania, and of which specimens were submitted to me by Mr. Lacoe, of Pittston, and Prof. Lesquereux. *Trochophyllum* I regard as closely allied to or perhaps congeneric with *Ptilophyton*, and in the report already referred to I have argued that these plants were probably aquatic.

Still more recently Prof. J. M. Clarke, of Northampton, Mass., was so kind as to send me two fragments of rock containing *Sporangites* similar to those above mentioned—one from the Genesee shale of Canandaigua, N. Y., and another from the Corniferous Limestone. In the latter these bodies retain their globular form, though some are partially crushed in such a way as to show their membranous character. In slices prepared by Prof. Clarke the wall is seen to be thin and carbonaceous, with indications of a dense cellular structure, and some of the specimens show a projecting aperture or point of attachment at one side, giving them a somewhat pear-shaped appearance. The size of all these macrospores from the Erian of New York is nearly the same with that of Lake Huron specimens. Those found with *Trochophyllum* in the Lower Carboniferous are much larger.‡

No certain clue seemed to be afforded by all these observations as to the precise affinities of these widely distributed bodies; but this was furnished shortly after from an unexpected quarter. In March, 1883, Mr.

*On the source of the Bituminous matter of the black shales of Ohio. Proc. Am. Asso. 1882.

†Report on Erian Plants of Canada, Part II.

‡Prof. Clarke has described his specimens in the American Journal of Science, April, 1885, and has noticed some interesting points to be referred to in the sequel.

Orville Derby, of the Geological Survey of Brazil, sent me specimens found along with fronds of *Spirophyton* in the Erian of that country, which seemed to throw a new light on the whole subject. These I described and pointed out their connection with *Sporangites* at the meeting of the American Association, at Minneapolis, in 1883, and subsequently published my notes respecting them in its Proceedings and in the Canadian Record of Science. Mr. Derby's specimens recalled to remembrance certain fossils which had been sent to me several years ago by the late Prof. Hartt, and which, like Mr. Derby's specimens, occurred in beds holding *Spirophyton*, though these were at that time regarded as carboniferous. In a note prepared for Prof. Hartt, but not, so far as I am aware, published, I had noticed these fossils as follows :

"*Sporangites*—Specimens from a shale at Rio Tapagos, above Itaituba.

"These are spore-cases, probably of a *Lepidodendroid* plant and resembling *S. Huronensis* of the Devonian of Canada. The specimens are labelled as Carboniferous, but the occurrence in them of abundant fronds of *Spirophyton* rather points to a Devonian date."

Mr. Derby's specimens contained *Spirophyton* and also minute rounded *Sporangites* like those obtained by Prof. Hartt. But they differed in showing the remarkable fact that these rounded bodies are enclosed in considerable numbers in spherical and oval sacs, the walls of which are composed of a tissue of hexagonal cells, and which resemble in every respect the involucres or spore-sacs of the little group of modern acrogens known as *Rhizocarps*, and living in shallow water. More especially they resemble the sporocarps of the genus *Salvinia*. This fact opened up an entirely new field of investigation, and I at once proceeded to compare the specimens with the fructification of modern *Rhizocarps*.

Mr. Derby's specimens are labelled as from Rio Trombetos and Rio Curua. They occur in two kinds of matrix. One is a thinly laminated sandy shale, tinged red with peroxide of iron, and with occasional ferruginous laminae. In this the spore-sacs are flattened and black, and show the structure of the walls under the microscope. The contained macrospores, when visible, appear as minute tubercles, or sometimes as depressions on the wall of the envelope, or more frequently as round light colored spots, according to their state of preservation. The other kind of matrix is a gray, dense shale in which the spore-sacs appear less flattened and usually destitute of carbonaceous matter.

The very numerous spore-sacs or sporocarps contained in these shales were so variable in size and form that they may have belonged to several species of plants, though on the other hand the differences might be attributed to age and state of preservation. They resolved themselves, however, into two leading types, which I named and described as *Sporangites Braziliensis* and *S. bilobata*, suggesting for them at the same

time the generic name *Protosalvinia*, in case the affinities which I think indicated by their structure should be fully established in the future. In the meantime I may adhere to the name *Sporangites*, which, though not technically correct, when applied to the individual macrospores, is sufficiently accurate when taken in connection with their occurrence in groups surrounded by cellular Sporocarps. Its priority and its use (since 1865) also give it claims to consideration. It will therefore be understood that when I use this term I refer to macrospores like those of the Lake Huron shale, as well as to Sporocarps containing macrospores, as in the Brazilian specimens. The equivalent term *Protosalvinia* I shall use as a prospective name to be applied to the whole plant so soon as this shall be known.

Since the publication of my paper on Rhizocarps in the Palaeozoic Period above referred to, I have received two papers from Mr. Edward Wethered, F. G. S., in one of which he describes spores of plants found in the Lower Limestone shales of the Forest of Dean, and in the other discusses more generally the structure and origin of Carboniferous Coal beds.* In both papers he refers to the occurrence in these coals and shales of organisms essentially similar to the Erian spores.

In the Bulletin of the Chicago Academy of Science, January, 1884, Dr. Johnson and Mr. Thomas, in their paper on the Microscopic Organisms of the Boulder Clay of Chicago and vicinity, notice *Sporangites Huronensis* as among these organisms, and have discovered them also in large numbers in the precipitate from Chicago city water supply. They refer them to the decomposition of the Erian shales, of which boulders filled with these organisms are of frequent occurrence in the Chicago clays. The *Sporangites* and their accompaniments in the boulder clay are also noticed in a paper by Dr. G. M. Dawson, in the Bulletin of the Chicago Academy, June, 1885.

Prof. Clarke has also described, in the American Journal of Science for April, 1885, the forms already alluded to and which he finds to consist of Macrospores enclosed in Sporocarps. He compares these with my *Sporangites Huronensis* and *Protosalvinia bilobata*, but I think it is likely that one of them at least is a distinct species.

I may add that in the Geological Magazine for 1875, Mr. Newton, F. G. S., of the Geological Survey, of England, published a description of the Tasmanite and Australian white coal, in which he shows that the organisms in these deposits are similar to my *Sporangites Huronensis*, and to the Macrospores previously described by Prof. Huxley, from the Betterbed coal. Mr. Newton does not seem to have been aware of my previous description of *Sporangites*, and proposes the name, *Tasmanites punctatus*, for the Australian form.

* Cotteswold Naturalists' Field Club, 1884. Journal of Royal Microscopical Society, 1885.

Mr. R. Kidston, F. G. S., has recently been engaged in the examination of the spores and sporangia contained in Devonian and Carboniferous deposits in Scotland, and some of which, as he informs me, are similar to those referred to in this paper; but I have not yet seen his published results.

To the kindness of Mr. Thomas I am indebted for a large series of microscopic preparations of these fossils, and of others in the Bedford shale of Ohio, prepared from specimens sent to him by Prof. Orton, the results of the microscopic examination of which I propose to notice, and to inquire as to the inferences which are now warranted respecting the affinities of these organisms.

II.—DESCRIPTION OF THE SPECIMENS.

The typical macrospores from the Erian shales are perfectly circular in outline, and in the flattened state appear as discs with rounded edges, their ordinary diameter being from $\frac{1}{75}$ th to $\frac{1}{100}$ th of an inch, though they vary considerably in size. This, however, I do not regard as an essential character. The edges, as seen in profile, are smooth, but the flat surface often presents minute dark spots, which at first, I mistook for papillæ; but now agree with Mr. Thomas in recognizing them as minute pores traversing the wall of the disc, and similar to those which Mr. Newton has described in Tasmanite, and which Mr. Wethered has also recognized in the similar spores of the Forest of Dean shales. The walls also sometimes show faint indications of concentric lamination, as if they had been thickened by successive deposits.

As seen by transmitted light, and either in front or in profile, the discs are of a rich amber color, translucent and structureless, except the pores above referred to. The walls are somewhat thick, or from $\frac{1}{10}$ th to $\frac{1}{8}$ th the diameter of the disc in thickness. They never exhibit the triradiate marking seen in spores of Lycopods, nor any definite point of attachment, though they sometimes show a minute elongated spot which may be of this nature, and they are occasionally seen to have opened by slits on the edge or front, where there would seem to have been a natural line of dehiscence. The interior is usually quite vacant or structureless, but in some cases there are curved internal markings which may indicate a shrunken lining membrane, or the remains of a prothallus or embryo. Occasionally a fine granular substance appears in the interior, possibly remains of microspores.

The discs are usually detached and destitute of any envelope, but usually fragments of flocculent cellular matter are associated with them, and in one specimen from the carboniferous limestone of Ohio, in Mr. Thomas' collection, I have found a group of eight or more discs partly enclosed in a cellular sac-like membrane of similar character to that enclosing the Brazilian specimens already referred to.

The characters of all the specimens are essentially similar, and there is a remarkable absence of other organisms in the shale. In one instance only, I have observed a somewhat smaller round body with a dark centre or nucleus, and a wide translucent margin, marked by a slight granulation. Even this, however, may indicate nothing more than a different state of preservation.

It is proper to observe here that the wall or enclosing sac of these macrospores must have been of very dense consistency, and now appears as a highly bituminous substance; in this agreeing with that of the spores of Lycopods, and like them, having been when recent of a highly carbonaceous and hydrogenous quality, very combustible and readily admitting of change into bituminous matter. In the paper already referred to, on spore-cases in coals, I have noticed that the relative composition of lycopodium and cellulose is as follows:

Cellulose $C_{24} H_{20} O_{20}$

Lycopodium $C_{42} H_{19\frac{4}{13}} N O 5\frac{6}{10}$.

Thus, such spores are admirably suited for the production of highly carbonaceous or bituminous coals, etc.

Nothing is more remarkable in connection with these bodies than their uniformity of structure and form over so great areas and throughout so great thickness of rock, and the absence of any other kind of spore-case. This is more especially noteworthy in contrast with the coarse coals and bituminous shales of the carboniferous, which usually contain a great variety of spores and sporangia, indicating the presence of many species of acrogenous plants, while the Erian shales on the contrary indicate the almost exclusive predominance of one form. This contrast is well seen in the Bedford shales overlying these beds, and I believe Lower Carboniferous.* Specimens of these have been kindly communicated to me by Prof. Orton, and have been prepared by Mr. Thomas. In these we see the familiar carboniferous spores with triradiate markings called *Triletes* by Reinsch, and which are similar to those of Lycopodiaceous plants. Still more abundant are those spinous and hooked spores or sporangia, to which the names *Sporocarpion*, *Zygosporites* and *Traquaria* have been given, and some of which Williamson has shown to be spores of Lycopodiaceous plants.†

The true "Sporangites" on the contrary are round and smooth, with thick bituminous walls, which are punctured with minute transverse pores. In these respects, as already stated, they closely resemble the bodies found in the Australian white coal and Tasmanite. The precise geological age of this material is not known with certainty, but it is believed to be Palaeozoic.

* According to Newberry, lower part of Waverly group.

† *Traquaria* is to be distinguished from the calcareous bodies found in the corniferous limestone of Kelly's Island, which I have described in the Canadian Naturalist as *Saccamina eriana*, and believe to be Foraminiferal tests. See Dr. Williamson's papers in transactions of Royal Society of London.

III.—MODE OF OCCURRENCE OF SPORANGITES, AND ITS BEARING ON THEIR ORIGIN.

Under this head we may note first the great abundance and wide distribution of these bodies. The horizontal range of the bed at Kettle Point is not certainly known, but it is merely a northern outlier of the great belt of Erian shales referred to by Prof. Orton, and which extends, with a breadth of ten to twenty miles, and of great thickness, across the State of Ohio, for nearly 200 miles. This Ohio black shale, which lies at the top of the Erian or the base of the Carboniferous, though probably mainly of Erian age, appears to abound throughout in these organisms and in some beds to be replete with them. In like manner, in Brazil, according to Mr. Derby, these organisms are distributed over a wide area and throughout a great thickness of shale holding *Spirophyton*, and apparently belonging to the Upper Erian. The recurrence of similar forms in the Tasmanite and white coal of Tasmania and Australia is another important fact of distribution. To this we may add the appearance of these macrospores in coals and shales of the Carboniferous period, though there in association with other forms.

It is also to be observed that the Erian shales, and the Forest of Dean beds described by Wethered, are marine, as shown by their contained fossils; and though I have no certain information as to the Tasmanite and Australian white coal, they would seem, from the description of Milligan, to occur in distinctly aqueous, possibly estuarine, deposits. Wethered has shown that the discs described by Huxley and Newton in the Better-bed coal occur in the earthy or fragmentary layers as distinguished from the pure coal. Those occurring in cannel coal are in the same case, so that the general mode of occurrence implies water-driftage, since in the case of bodies so large and dense, wind-driftage to great distances would be impossible.

These facts, taken in connection with the differences between these macrospores and those of any known land plant of the Palaeozoic, would lead to the inference that they belonged to aquatic plants, and these vastly abundant in the waters of the Erian and Carboniferous periods.

It is still further to be observed that they are not, in the Erian beds, accompanied with any remains of woody or scalariform tissues such as might be expected in connection with the debris of terrestrial acrogens, and that, on the other hand, we find them enclosed in cellular sporocarps, though in the majority of cases these have been removed by dehiscence or decay.

These considerations, I think, all point to the probability which I have suggested in my previous paper on this subject, that we have in these objects the organs of fructification of plants belonging to the order *Rhizocarpeæ*, or akin to it. The comparisons which I have instituted with the

sporocarps and macrospores of these plants confirm this suggestion. Of the modern species which I have had an opportunity to examine, *Salvinia natans* of Europe perhaps presents the closest resemblance. In this plant groups of round cellular sporocarps appear on the surface of the floating fronds. They are about a line in diameter when mature, and are of two kinds, one containing macrospores, the other microspores or antheridia. The first, when mature, hold a number of closely packed globular or oval sporangia of loose cellular tissue attached to a central placenta. Each of these sporangia contains a single macrospore, perfectly globular and smooth, with a dense outer membrane (exhibiting traces of lamination, and showing within an irregularly vacuolated or cellular structure, probably a prothallus). I can not detect in it the peculiar pores which appear in the fossil specimens. Each macrospore is about one-seventieth of an inch in diameter when mature. The sporocarps of the microspores contain a vastly greater number of minute sporangia, about one two-hundredths of an inch in diameter. These contain disc-like antheridia, or microspores of very minute size.

The discs from Kettle Point and from the Ohio black shale, and from the shale boulders of the Chicago clays, are similar to the macrospores of *Salvinia*, except that they have a thicker wall and are a little less in diameter, being about one-eightieth of an inch. The Brazilian sporocarps are considerably larger than those of the modern *Salvinia*, and the macrospores approach in size to those of the modern species, being one-seventy-fifth of an inch in diameter. They also seem, like the modern species, to have thinner walls than those from Canada, Ohio and Chicago. No distinct indication has been observed in the fossil species of the inner Sporangium of *Salvinia*. Possibly it was altogether absent, but more probably it is not preserved as a distinct structure.

With reference to the microspores of *Salvinia*, it is to be observed that the sporocarps, and the contained spores or antheridia, are very delicate and destitute of the dense outer wall of the macrospores. Hence such parts are little likely to have been preserved in a fossil state; and in the Erian shales, if present, they probably appear merely as flocculent carbonaceous matter not distinctly marked, or as minute granules not well defined, of which there are great quantities in some of the shales.

The vegetation appertaining to the Sporangites has not been distinctly recognized. I have, however, found in one of the Brazilian specimens two sporocarps attached to what seems a fragment of a cellular frond, and numerous specimens of the supposed Algæ, named *Spirophyton*, are found in the shales, but there is no evidence of any connection of this plant with the Protosalvinia.

Modern Rhizocarps present considerable differences as to their vegetative parts. Some, like *Pilularia*, have simple linear leaves; others, like

Marsilea, have leaves in verticils and cuneate in form; while others, like *Azolla* and *Salvinia*, have frondose leaves, more or less pinnate in their arrangement. The first type presents little that is characteristic, but there are in the Erian sandstones and shales great quantities of filamentous and linear objects which it has been impossible to refer to any genus, and which might have belonged to plants of the type of *Pilularia*. It is quite possible, also, that such plants as *Psilophyton glabrum* and *Cordailes angustifolia*, of which the fructification is quite unknown, may have been allied to Rhizocarps. With regard to the verticillate type, we are at once reminded of *Sphenophyllum*, which many palæo-botanists have referred to the *Marsiliaceæ*, though like other Palæozoic Acrogens, it presents complexities not seen in its modern representatives, *S. primævum* of Lesquereux is found in the Hudson River group, and my *S. antiquum* in the Middle Erian. Besides these, there are in the Silurian and Erian beds plants with verticillate leaves which have been placed with the Annulariæ, but which may have differed from them in fructification. *Annularia laxa*, of the Erian, and *Protannularia Harknessii*, of the Silurio-Cambrian, may be given as examples, and must have been aquatic plants, probably allied to Rhizocarps. It is deserving of notice, also, that the two best known species of *Psilophyton* (*P. princeps* and *P. robustius*), while allied to Lycopods by the structure of the stem and such rudimentary foliage as they possess, are also allied, by the form of their fructification, to the Rhizocarps, and not to ferns, as some palæo-botanists have incorrectly supposed.

The curious plants known as *Arthrostigma*, seem also to have been allied to *Psilophyton* in their fruit, though bearing it in spikes instead of as separate sporocarps.*

I would also here direct attention to those pinnate leaves from the Erian and Carboniferous, which I have named *Ptilophyton*, and to those from the Carboniferous, which Lesquereux has named *Trochophyllum*. I have fully discussed the structure of these in my Report of 1882 on the Erian Plants of Canada, and may here merely state that I have shown that they were aquatic plants, probably bearing sporocarps attached to their stems somewhat in the manner of *Azolla*.

The whole of this evidence, I think, goes to show that in the Erian period there were vast quantities of aquatic plants allied to the modern Rhizocarps, and that the so-called Sporangites referred to in this paper were probably the drifted sporocarps and macrospores of some of these plants or of plants allied to them in structure and habit, of which the vegetative organs have perished. I have shown that in the Erian period there were vast swampy flats covered with *Psilophyton*, and in similar submerged tracts near to the sea the *Protosalvinia* may have filled the waters and have given off the vast multitudes of Macrospores which drifted by currents have settled in the mud of the black shales.

* Report on Erian Plants of Canada, Part II, 1882.

III.—CLASSIFICATION OF SPORANGITES.

It is, of course, very unsatisfactory to give names to mere fragments of plants, yet it seems very desirable to have some means of arranging them. With respect to the organisms of the present paper, which were originally called by me *Sporangites*, under the supposition that they were Sporangia rather than Spores, this name has so far been vindicated by the discovery of the spore-cases belonging to them, so that I think it may still be retained as a provisional name; but I would designate the whole as *Protosalvinia*, meaning thereby plants with Rhizocarpean affinities, though possibly when better understood belonging to different genera. We may under these names speak of their detached discs as macrospores and of their cellular envelopes as sporocarps. The following may be recognized as distinct forms.

1.—*Protosalvinia Huronensis*, Dawson, Syn., *Sporangites Huronensis*, Report on Erian Flora of Canada, 1871.—Macrospores in the form of discs or globes, smooth and thick-walled, the walls penetrated by minute radiating pores. Diameter about $\frac{1}{10}$ th of an inch or a little more. When in situ several macrospores are contained in a thin cellular sporocarp, probably globular in form. From the Upper Erian, and perhaps Lower Carboniferous shales of Kettle Point, Lake Huron, of various places in the State of Ohio, and in the shale boulders of the boulder clay of Chicago and vicinity. First collected at Kettle Point by Sir W. E. Logan, and in Ohio by Prof. Edward Orton, and at Chicago by Dr. H. A. Johnson and Mr. B. W. Thomas, also in New York by Prof. J. M. Clarke.

The macrospores collected by Mr. Thomas from the Chicago clays and shales conform closely to those of Kettle Point, and probably belong to the same species. Some of them are thicker in the outer wall, and show the pores much more distinctly. These have been called by Mr. Thomas *S. Chicagoensis*, and may be regarded as a varietal form. Specimens isolated from the shale and mounted dry, show what seems to have been the hilum or scar of attachment better than those in balsam.

Sections of the Kettle Point shale show, in addition to the Macrospores, wider and thinner shreds of vegetable matter, which I am inclined to suppose to be remains of the Sporocarps.

2.—*Protosalvinia (Sporangites) Braziliensis*, Dawson, Can. Rec. of Sci., 1883.—Macrospores, round, smooth, a little longer than those of the last species, or about $\frac{1}{8}$ th of an inch in diameter, enclosed in round, oval or slightly reniform sporocarps, each containing from four to twenty-four macrospores. Longest diameter of sporocarps three to six millimeters. Structure of wall of sporocarps hexagonal cellular. Some sporocarps show no macrospores, and may possibly contain microspores. The specimens are from the Erian of Brazil. Discovered by Mr. Orville Derby. The formation, according to Mr. Derby, consists of black shales below, about

300 feet thick, and containing the fucoid known as *Spirophyton*, and probably decomposed vegetable matter. Above this is chocolate and reddish shale in which the well preserved specimens of *Protosalvinia* occur. These beds are very widely distributed and abound in *Protosalvinia* and *Spirophyton*.

3.—*Protosalvinia* (*Sporangites*) *bilobata*, Dawson, Can. Rec. of Science, 1883.—Sporocarps, oval or reniform, three millimeters to six millimeters in diameter, each showing two rounded prominences at the ends, with a depression in the middle, and sometimes a raised neck or isthmus at one side connecting the prominences. Structure of sporocarp cellular. Some of the specimens indicate that each prominence or tubercle contained several macrospores. At first sight it would be easy to mistake these bodies for valves of *Beyrichia*.

Found in the same formations with the last species, though in so far as the specimens indicate, not precisely in the same beds. Collected by Mr. Derby.

4.—*Protosalvinia* *Clarkei*, Dawson, P. *bilobata*, Clarke, Am. Jl. of Science.—Macrospores $\frac{3}{4}$ to 1 millimeter in diameter. One, two or three contained in each sporocarp, which is cellular. The macrospores have very thick walls with radiating tortuous tubes. Unless this structure is a result of mineral crystallization, these macrospores must have had very thick walls and must have resembled in structure the thickened cells of stone fruits and of the core of the pear, or the tests of the Silurian and Erian seeds known as *Pachytheca*, though on a smaller scale.

It is to be observed that bodies similar to these occur in the Boghead earthy bitumen and have been described by Credner.

I have found similar bodies in the so-called "Stellar coal" of the coal district of Pictou, Nova Scotia, some layers of which are filled with them. They occur in groups or patches, which seem to be enclosed in a smooth and thin membrane or sporocarp. It is quite likely that these bodies are generically distinct from *Protosalvinia*.

5.—*Protosalvinia* *punctata*, Newton, Geol. Mag. N. S. Dec. 2, vol. II. Mr. Newton has named the discs found in the white coal and Tasmanite, *Tasmanites*, the species being *Tasmanites punctatus*, but as my name *Sporangites* had priority, I do not think it necessary to adopt this term, though there can be little doubt that these organisms are of similar character. The same remark may be made with reference to the bodies described by Huxley and Newton as occurring in the Better-bed coal.

V.—GENERAL REMARKS.

It may be well to mention here the various characters of pyroschists or bituminous shales of different ages, as they have come under my notice.

The Utica shale of Collingwood, Ontario, which has been used for the distillation of coal oil, shows under the microscope only flocculent matter and slender spicules, and its bitumen seems to have been derived from the disintegration of algæ and zoophytes.

A specimen of inflammable shale from the Trenton of Minnesota, prepared by Mr. Thomas, shows similar shreds of organic matter without any macrospores.

Bituminous shales associated with a small layer of coal in the middle Erian of Gaspé, show great quantities of shreds of epidermal tissue and fragments of the chitinous crusts of Eurypterids, but no distinct macrospores.

The richly bituminous shales of the Lower Carboniferous of Albert county, New Brunswick, which have furnished the material of the Albertite or hardened bitumen of that district, have not afforded any macrospores in the specimens I have been able to examine, but are filled with shreds apparently of vegetable matter in a much disintegrated state.

The Bedford shales of Ohio contain, in addition to fragments of epidermal and woody and vascular tissue, many forms of macrospores quite distinct from those of the underlying Erian shales. A similar remark may be made as to many varieties of coarse coal, cannel coal and bituminous shale of the coal measures, in which many forms of macrospores and sporangia may be found mixed with shreds of the more durable tissues, and especially of the epidermal tissue of various kinds of plants. Dr. Newberry, and Mr. Julian have described in the *Annals of the N. Z. Academy of Science*, 1883, a number of specimens of bituminous shales not containing Sporangites, and Dr. Newberry refers the bituminous matter to the decomposition of algæ, or in some cases to that of miscellaneous vegetable débris from the land, a conclusion which he has applied also to the cannel coals.

From these facts it would appear that the presence of Rhizocarpean macrospores is not a necessary condition of the formation of bituminous shales, earthy bitumens or coals. Yet it seems certain that the macrospores are the cause of the highly bituminous character of the shales which are charged with them. On the other hand, many highly bituminous shales, such as, for instance, some beds of the Utica shale and the Lower Carboniferous shales of Albert county, New Brunswick, depend for their inflammable matter on microscopic débris of an entirely different character.

In point of fact* any kind of epidermal or dense cortical tissue has chemical properties not very dissimilar from those of the tests of macrospores; and such tissues have, as I have elsewhere shown,† been mainly instrumental in the production of coal, in some layers of which, however, macrospores and sporangia occur in large quantity. In regard to strictly marine shales, while it is probable or suggested by Newberry, that algæ may have furnished the material of much of the bituminous matter, I confess I am inclined to attach some importance in this respect to the corneous substance of Graptolites and other Zoophytes, which is nearer in composition to corky and epidermal matter.

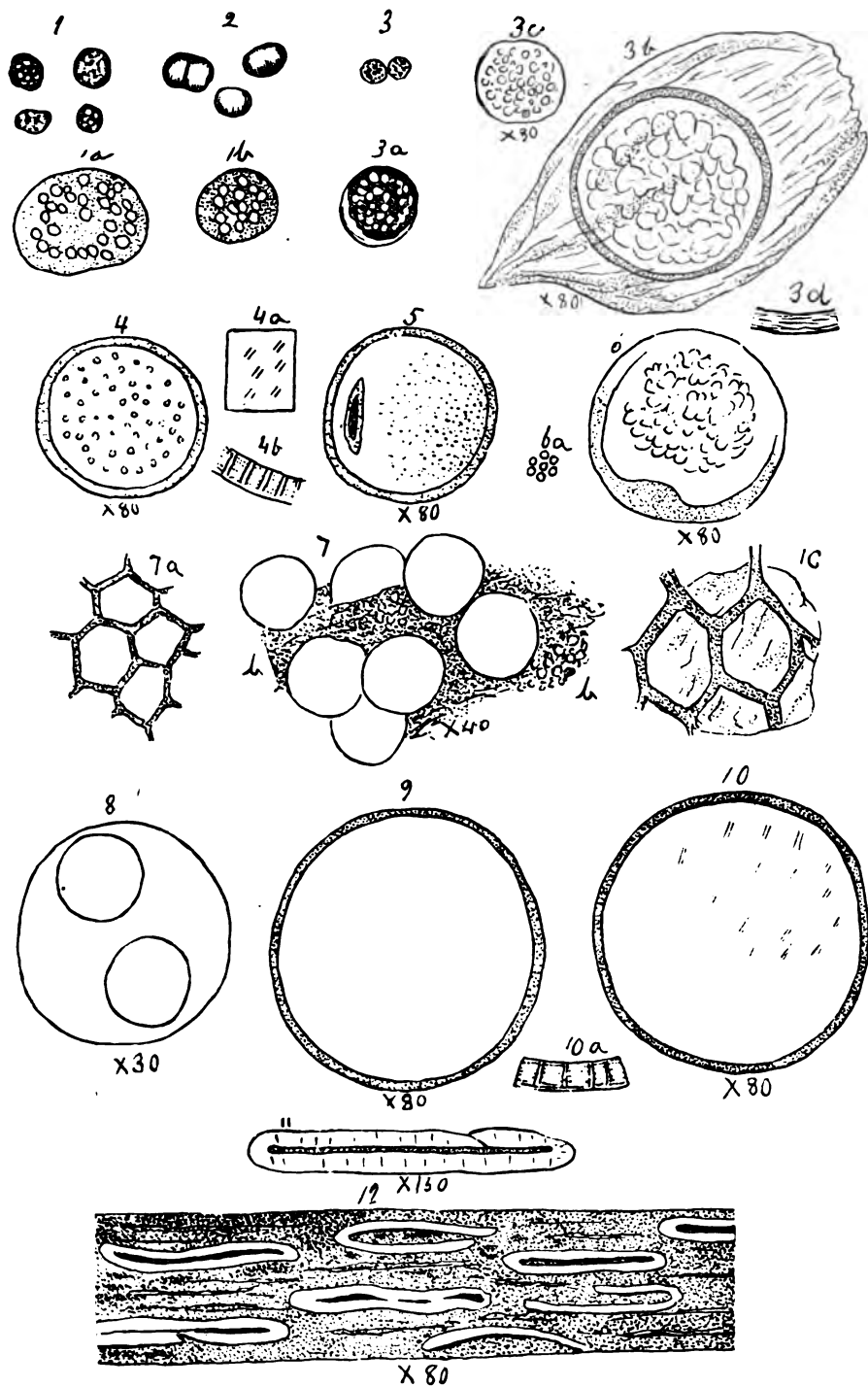
In a botanical point of view the facts stated in this paper show that in the Erian, and probably also in the Carboniferous age, the type of plants now represented by the Rhizocarps was very largely developed, and that the macrospores of these plants were produced in such abundance as to charge great thicknesses of shales over very large areas with these bodies, which, owing to the density and indestructible character of the outer test, have resisted decomposition and remain unmineralized in the mass, giving to it the same highly combustible character which would result from the mixture of a like amount of Lycopodium spores with similar sediment.

*See my paper on Spore-cases in Coal. American Journal of Science, 1871.

†Journal of Geol. Society of London, 1865, and American Journal of Science, 1871. Also Acadian Geology, 1878.

Description of Figures.

- Figure 1. Protosalvinia (sporangites) Braziliensis, sporocarps and spores, nat. size. 1a, 1b, same enlarged; 1c, cellular tissue of sporocarp much magnified.
- Figure 2. P. (sp.) bilobata, nat. size.
- Figure 3. Salvinia natans, modern, sporocarps, nat. size.
 3a. Sporocarp with macrospores enlarged.
 3b. Macrospores with sporangium, $\times 80$.
 3c. Sporangium with microspores $\times 80$.
 3d. Wall showing lamination.
- Figure 4. P. (sp.) Huronensis, macrospore $\times 80$, showing pores, 4a, 4b, portions of wall more magnified.
- Figure 5. P. (sp.) Huronensis, showing hilum and internal granular matter $\times 80$.
- Figure 6. P. (sp.) Huronensis with thickened wall $\times 80$, 6a, nat. size.
- Figure 7. P. (sp.) Huronensis, group with remains of sporocarp; Corniferous Limestone. $\times 40$. 7a cellular tissue of sporocarp highly magnified.
- Figure 8. P. Braziliensis, sporocarp and 2 macrospores, outline, $\times 30$.
- Figure 9. P. Braziliensis, Macrospore $\times$.
- Figure 10. P. (Tasminites) punctatus, $\times 80$, showing pores; 10a, wall highly magnified, showing pores.
- Figure 11. P. (sp.) Huronensis, Section $\times 150$.
- Figure 12. Shale from Kettle Point, showing flattened macrospores and remains of sporocarps, $\times 80$.





Vol. I.

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No. X.

BULLETIN
OF THE
CHICAGO ACADEMY OF SCIENCE.

A PAPER ON
Elephas Primigenius.

BY W. K. HIGLEY, Ph.D.

CHICAGO:
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1886.

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ELEPHAS PRIMIGENIUS.

By W. K. HIGLEY, PH. D.

(READ AT OCTOBER MEETING, 1886.)

During the past summer the Academy Museum has been enriched by a mounted specimen of that enormous animal of past ages, the mammoth, *Elephas primigenius*.

For this addition to our collection we are indebted to our President, Dr. Edmund Andrews, who with much labor kept the skeleton in view for many years, till the price was reduced to a reasonable sum, when he interested the following gentlemen in the matter, who, with himself, purchased the bones and presented them to the Academy: Hon. Wm. Bross, Philip D. Armour, John Crerar, Norman Williams, Joseph Frank, Wirt Dexter, Hamilton B. Bogue and the members of the Mastodon Club. Thus, by the kindness of these gentlemen the Academy comes into possession of the only bones, I believe, ever found in this country in a sufficient state of preservation or numbers to permit of mounting.

Inspection proved that these remains were not only worthy of our attention in the unmounted state, but also that they were in such a condition that they could, by restoring certain parts, be placed in their natural position. It was deemed wise to mount them, for in this condition they would be much more instructive. This was attempted and for the grand result of the effort, which stands in the museum, the second mounted mammoth in the world, the Academy is indebted to Dr. J. W. Velie, assisted by Messrs. J. L. Hancock, Kuh, C. S. Babcock and Dr. Wyllys Andrews. These gentlemen volunteered their services and worked arduously and skillfully for the greater part of two months.

The bones were found in the spring of 1878, in the southwest part of Spokane County, Wash., on the farm of a Mr. Copelin. The country is a rolling prairie, about 2,100 feet above the sea, extending from the Rocky Mountains to the Cascade Range. The water-courses are timbered, the rest treeless. The soil is a rich black loam with white clay subsoil. Hang-

man's Creek, about 350 feet wide, runs through this part of the county into the Spokane River, which is a tributary of the Columbia. The prairie is an excellent grain land, and in the wild state produces grass thirty inches high.

The remains of four mammoths were found on the upland in a marshy hollow, about fifty feet in diameter, formed by a spring oozing out of the black mud, whose waters flowed off in a narrow valley to Hangman's Creek, about three-fourths of a mile distant. The bones were exposed while ditching in order to drain the spot.

A very perfect skeleton of a smaller animal, supposed, by a gentleman who saw it, to be a horse, was exposed with the mammoth bones. It is worthy of note that in this spring-hole cattle and other animals were occasionally mired.

Neither of the four skeletons found was complete, and in mounting, it was not always possible to tell one individual from another. Besides the four adult skeletons, there was a fragment of a small pelvis, probably from a fœtus of one of the female mammoths dying pregnant.

The following is a list of bones found:

- 3 lower jaws, with teeth perfect.
- 13 cervical vertebræ.
- 20 dorsal vertebræ.
- 4 lumbar vertebræ.
- 9 caudal vertebræ.
- 1 sacrum.
- 2 pelves, one entire, and one supposed fœtal fragment.
- 3 scapulas.
- 2 femurs, one a fragment.
- 1 patella.
- 1 ulna, a fragment.
- 2 humeri, one a fragment, and the other from another locality.
- 6 tusks.
- 7 upper molars and fragments.
- 32 ribs.
- 1 skull, merely some small fragments.
- 14 bones of the feet.

Thus the total number of bones, or their fragments, found was 121.

The total weight of the bones was about 700 pounds.

It will be noticed that the most important bones needed in making the measurements necessary for supplying the lost parts, in the process of restoration, were present. The work of restoration was done with conscientious care, using, when necessary, the bones of one of the smaller animals as patterns in modeling for the larger. In a few cases the bones of the *Elephas Indicus*, which are almost identical in form, served as patterns.

The height as it stands is 13 feet, while that of the St. Petersburg mammoth is only 9 feet 3 inches.

It will be of interest to compare the height of a few elephantine forms.

Jumbo's skeleton, *Elephas Africanus*, is 10 feet 3 inches; Warren's *Mastodon giganteus*, at Boston, is 11 feet, and the Hauser *Elephas Indicus* at Northwestern University, Evanston, Ill., is 10 feet 8 inches.

If we allow two inches for the gristly cushion under the feet, and three inches for the thickness of the flesh on its back, and some few inches for the wool and bristly mane, which is said to have crested the spine in the St. Petersburg specimen, it would seem that this animal, when living, must have been about 14 feet in height.

Some elephantine bones of great size have been reported from our western territories and attributed to *Elephas imperator*. If there is any adequate proof of such a species, our enormous specimen doubtless belongs to it, but the great size is not sufficient to prove a separate species when three smaller individuals were found in the same small area. Besides, the tusks have the peculiar and strong curve characteristic of the *Elephas primigenius*, and not known in any other elephant. The tusks were 9 feet 10 inches long measured on the outer curvature.

The teeth also correspond with those of the mammoth.

The following are some measurements of true bones in the mounted skeleton:

Length of tusk, 9 feet 10 inches.

Circumference of tusk at the base, 21 inches.

Number of laminae of lower teeth, 19.

Breadth of lower teeth, $3\frac{1}{2}$ inches.

Length of lower teeth, 10 inches.

Breadth of lower jaw at the condyles, 23 inches.

Length of lower jaw, 22 inches.

Breadth of atlas, 18 inches.

Height of atlas, $9\frac{1}{2}$ inches.

Height of pelvis, 34 inches.

Breadth of pelvis, 62 inches.

Height of scapula, 39 inches.

Breadth of scapula, 25 inches.

Length of humerus, 45 inches.

Circumference of humerus at middle of shaft, 19 inches.

Dana says: "This ancient elephant was over twice the weight of the largest modern species, and nearly a third larger. The body was covered with a reddish wool and long black hair. One of the tusks measured $12\frac{1}{2}$ feet in length; it was curved nearly into a circle, though a little obliquely.

* * * At the mouth of the Lena one of these animals was found, at the beginning of this century, frozen and encased in ice. It measured 16 feet

4 inches in length to the extremity of the tail, exclusive of the tusks, and 9 feet 4 inches in height. It retained the wool on its hide, and was so perfectly preserved that the flesh was eaten by the dogs." [Manual of Geology, p. 565.]

So far as I am able to find, the species in Europe does not, on the average, exceed the stature of the living elephants, but this may be an error, or it may be that the climate and soil of our Western mountains and plains favored a larger stature in the species than in Siberia and Europe.

Perhaps at this point it would not be out of place to mention the "Lenape Stone," which has been made the subject of an exhaustive study by Mr. H. C. Mercer. This stone was found in Bucks County, Penn., in 1872. It has given rise to considerable discussion concerning its authenticity. A drawing on the stone represents the Indians in battle with the "hairy mammoth." Mr. Mercer holds that this is evidence indicating that the mammoth was contemporaneous with the American Indians. He believes in its authenticity, and has collected considerable evidence supporting his opinions, giving them to the public in a monograph published by G. P. Putman's Sons.

The spring-hole, in which the mammoth remains were found, was about 6 or 8 miles from a range of the Rocky Mountain system which separates the prairie country from Lake Coeur d'Alene. These mountains are heavily timbered everywhere. The habits of all the wild animals there is to keep to the mountains in the summer, but to retire to the prairie at the approach of winter, and the following spring to follow the receding snow up the mountain side again. Probably the mammoth did likewise. Prof. Baird says mammalian animals in general are taller and larger in proportion as their habitat is well north or in mountainous regions. This, with good food, may have resulted in an enormous growth. It may be that the grass on the fertile prairie, growing very luxuriantly, may have served as a food.

The mammoth, and in fact all elephantine remains, are usually found in groups composed of two or more individuals. At least four animals were entombed in one spot at the locality where the Academy specimen was found. Our former Director, Robert Kennicott, reported that in Alaska the bones of this species sometimes lie in clusters of several individuals. The Indians informed him of a valley where immense numbers of elephantine bones lay due, as they supposed, to a great battle among supernatural beings.

Dr. Stimpson exhumed, at Fort Wayne, Ind., three mastodons from one spot. In the island of Malta the extinct elephants are said to be huddled together in the upper valleys. It is thought by some that they were driven up by a submergence, and perished in groups in consequence.

The natives around the elephant lands of Hindostan think that the animals are in the habit of resorting to certain spots, deep in the forest, when they feel the approach of death, and thus leave their bones in groups.

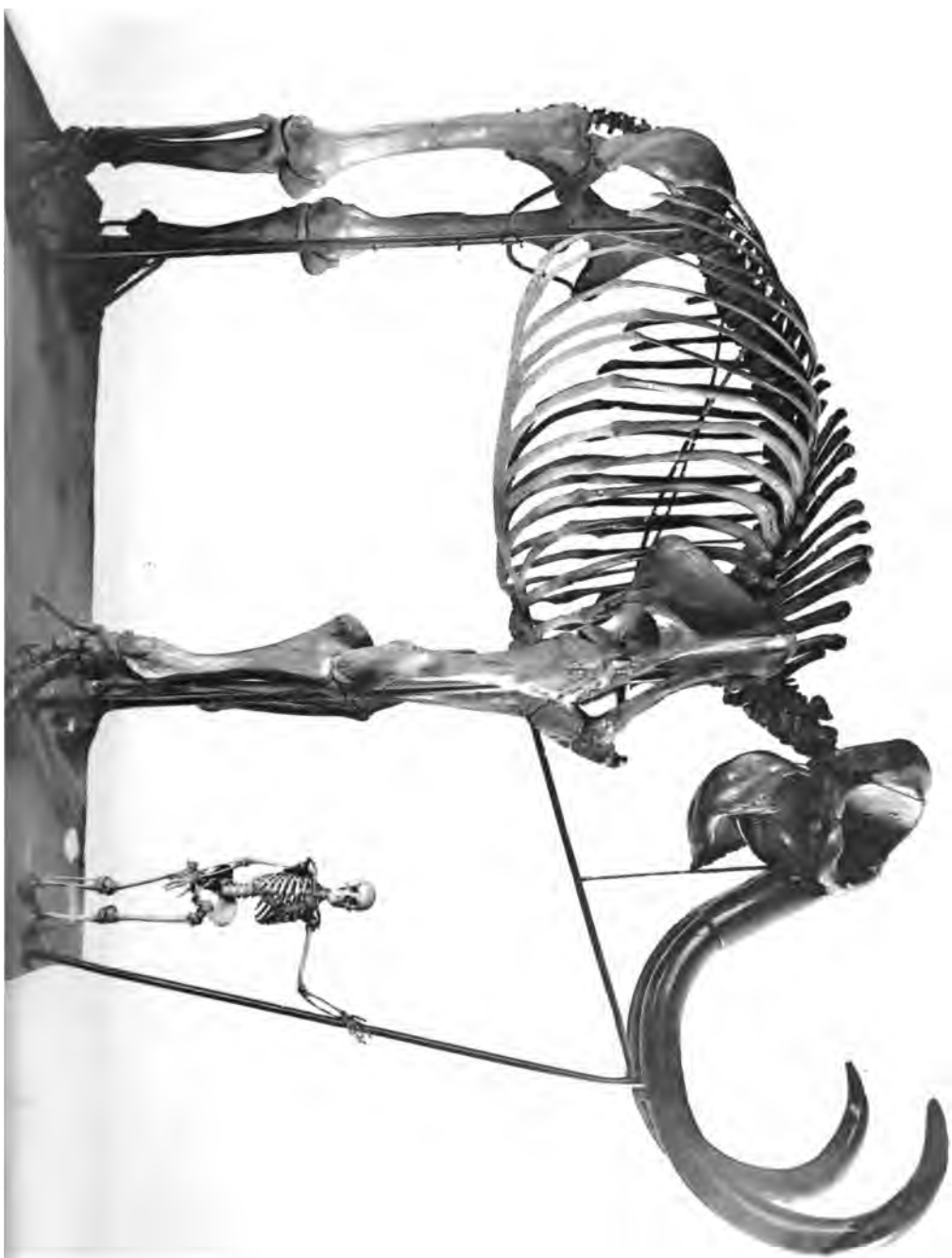


If vast numbers exist in elevated valleys we might naturally admit the theory of their being driven together by the submergence which enclosed the Siberian specimen in frozen mud; but when only three or four are found together, we believe that the following theory is more plausible.

Animals, like men, when taken with fatal diseases, often suffer with thirst long after they have lost all desire for food and in fact have become too weak to travel after it. They might, therefore, be expected to loiter in and around their drinking places and to die there, one at a time, but ultimately accumulating in numbers.

Prof. Marsh, of Yale, informed Dr. Andrews that he had an unmounted Siberian mammoth in the museum store-room. So far as we know, that one and ours are the only nearly complete skeletons in this country, and ours the only mounted one.







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Vol. II.

No. I.

BULLETIN

—OF THE—

Chicago Academy of Sciences.

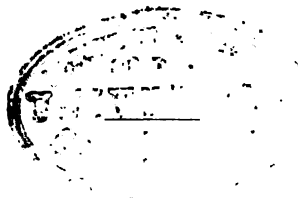
THE FLORA OF COOK COUNTY, ILLINOIS, AND
A PART OF LAKE COUNTY, INDIANA.

—BY—

WILLIAM K. HIGLEY

—AND—

CHARLES S. RADDIN.



CHICAGO:

1891.



PREFACE.

From the earliest period of botanical research, to our own time, treatises and catalogues have been prepared, each adding something to the information contributed by its predecessors, until the plant life of the world is more or less familiar to us.

Modern facilities of transportation, as well as the agencies of birds, winds and water, tend in so great a measure to disseminate seeds, that it is highly important to keep a record both of the new forms introduced and of those that have disappeared, and of the habits and variations of them all.

In publishing the Flora of Cook County, Illinois, and a Part of Lake County, Indiana, we endeavor to meet the requirements of many local botanists, who have long felt the need of such a record, none having been issued, with the exception of Patterson's State Report, since the publication of Prof. Babcock's list, in Vols. I and II of the *Lens* (1872-'73).

The importance of a new enumeration (which includes the phænogamia and vascular cryptogamia) will be seen, when it is realized that about 540 plants not recorded by Prof. Babcock, and 182 not mentioned by Patterson, are included in the present catalogue. It should be stated, however, that of the plants omitted by Prof. Babcock, many are species formed since his time, species introduced by cultivation or otherwise, and now growing spontaneously, or varieties of recent formation. There are also some species enumerated by Prof. Babcock, but not reported as growing within our limits; the area included by him embracing a territory having a radius of forty miles from Chicago.

Fifteen plants are recorded that are not included in the 5th Ed. of Gray's *Manual*:

Lepidium sativum, L.
Oleome integrifolia, T. & G.
Lechea minor, L.
Gaura parviflora, Dougl.
Carum carui, L.
Grindelia squarrosa, Dunal.
Tragopogon porrifolius, L.
Tragopogon pratensis, L.

Lactuca lucophæa, var. *integrifolia*, Gray.
Solanum carolinense, L., var. *floridanum*, Chap.
Solanum rostratum, Dunal.
Gerardia purpurea, L., var. *paupercula*, Gray.
Anychia capillacea, D C.
Potamogeton fluitans, Roth.

The following species not being recorded in the 6th Ed. of Gray's *Manual*, a description of them is given in this catalogue: *Lepidium sativum*, L., *Lechea minor*, Lam., var. *stricta*, Leggett and *Solanum carolinense*, L., var. *floridanum*, Chap.

Cornus baley, Coult. & Evans, and *Cnicus hillii*, Wm. Canby, also unrecorded, are recent species.

It has been our plan, with the assistance of co-laborers, by exhaustive field work and examination of private lists and herbaria, not only to catalogue the plants growing in our area, but to give information concerning their natural

habitat, season of flowering, frequency of occurrence, and variations of life and growth, and also to speak of the localities of the rarer forms and of the disappearance of species, and to give such other notes as are of scientific interest. For the purpose of aiding collectors, localities are mentioned, in many cases, for species that are not especially rare.

The exclamation point following an authority for location of species, is employed to show that the writers have also found the plant in the locality indicated. In order to designate plants not heretofore listed by Babcock and Patterson, the initials B. and P. have been appended. Introduced forms are placed in small capitals. It is probable that some of the rarer forms have been introduced, but owing to the absence of any complete catalogue indicating the previous condition of our flora, we have listed them as native, when found growing apparently in a natural state.

The area included in the Flora, is Cook County, Illinois, and that portion of Lake County, Indiana, situated north of the Little Calumet river. All plants recorded, with the exception of a few mentioned by Babcock, which are admitted on his authority, have been examined either by ourselves, or by Prof. E. J. Hill, and are contained in herbaria in Chicago and vicinity.

The causes of extermination within our limits are varied. The phenomenal growth of Chicago and the establishment of manufactories in the suburbs, as well as the cutting of the forest growths, have largely tended to change the complexion of our native flora.

As the catalogue is intended to be used in connection with the 6th edition of Gray's Manual, it has been considered best to follow its general arrangement. While we cannot entirely endorse the nomenclature used in the 6th edition, we have adopted it with the following exceptions:

Hepatica triloba, Chaix., is *Anemone hepatica*, L.

Hepatica acutiloba, DC., is *Anemone acutiloba*, Lawson.

Nymphaea, is *Castalia*, Salisb.

Nuphar, is *Nymphaea*, L.

Lechea minor, L., var. *maritima*, Gray, is *L. maritima*, Leggett.

Viola palmata, L., var. *ocullata*, Gray, is *V. cucullata*, Ait.

Carya, is *Hicoria*, Raf.

Quercus coccinea, Wang., var. *tinctoria*, Gray, is *Q. tinctoria*, Bartram.

The Coniferae have been placed in their more natural position, at the end of the Monocotyledons.

In all cases the nomenclature of the 5th Ed. of Gray's Manual has been shown, when differing from the 6th.

It is fitting that this catalogue, following the list of Prof. Babcock, which was the first and only botanical record of this section, should contain a tribute to his personal worth and his valuable contributions to the science of botany, and it is well that this recognition of his ability should come from his friend, Prof. E. S. Bastin, to whom we are also indebted for many notes and suggestions.

The authors desire to acknowledge the generous assistance of Dr. Oliver Marcy, who during the many years in which he has been an honored professor in Northwestern University, has become thoroughly acquainted with the geology and the natural history of this region.

The editing of the Genera *Lechea* and *Potamogeton*, and the revision of the genus *Carex*, are by Prof. E. J. Hill, who has also contributed valuable notes.

Oniscus hillii, mentioned above, is named in honor of Prof. Hill, in recognition of his study of the genus *Oniscus*.

We wish to make mention of the valuable assistance rendered by M. S. Bebb, Esq., Dr. Geo. Vasey and Professors H. F. Monroe, G. A. Brennan, Henry L. Boltwood, L. N. Johnson, S. S. Dodge, J. B. Williams, as well as many others among our local botanists and teachers of natural history.

If we would keep pace with the continuous changes in the flora of Chicago and vicinity, it is absolutely necessary that constant investigation be carried on. On account of this, we hope that all local botanists will keep a record of all species they may discover which are not already catalogued, and of the new localities in which rarer forms may be found, as well as of the disappearance of species from localities mentioned in this work. And we make the request that they will send reports of their observations, accompanied by specimens, which will be returned if desired, to the Chicago Academy of Sciences. These notes will be used in the preparation of a more elaborate flora at some future date.

The compilation of the Flora closed with the season of 1890, and additions since that time will be found in Appendix I.

THE EDITORS.

Academy of Sciences, Chicago, June 1st, 1891.

BRIEF SKETCH OF THE LIFE AND WORK OF HENRY HOMES BABCOCK.

No Flora of Chicago and vicinity could now be written that would adequately represent both what this flora once was and what it now is, that did not employ the valuable results of the labors of earlier botanists engaged in this same field. For, owing to the concentration here of a great population, vast changes have been wrought in recent years in the flora of this locality. Many species which were once abundant have become rare or have disappeared altogether, while many new ones have been introduced from adjacent localities or from abroad.

Among the earlier local botanists, there were none whose contributions to the knowledge of our flora were comparable to those of the late Professor H. H. Babcock, whose "Catalogue of the Plants of Chicago" constitutes the basis of this *Flora*. It seems appropriate, therefore, and just to the memory of an able botanist, that this work should include at least a brief sketch of his life and services to botanical science.

Henry Homes Babcock was born of New England parentage, in Thetford, Vermont, December 19, 1832. Both of his parents were educated people, his father being a Congregational clergyman and a graduate of Amherst College, and his mother a graduate of Bradford Academy, when that school was under the directorship of Hon. Benjamin Greenleaf, of mathematical fame. From both, therefore, he inherited scholarly tastes and aptitudes, and from early childhood he breathed an atmosphere of culture and refinement. We need not be surprised that he early manifested a preference for scholarly pursuits or that he was fully prepared for college while yet much too young to enter. His surroundings at this early period of his life seem also to have been particularly fitted to awaken in the mind of so thoughtful a youth a love of natural history pursuits. The parsonage woods at Thetford, abounding as they did with interesting plants and animals, were a constant pleasure to him and as much a source of instruction as his books. It was here that he acquired the mental bias which determined him to the career of a naturalist, a fact which he himself in after life gratefully recognized.

He was the eldest of five children, and when, at the age of sixteen, his father died and his mother was left with but limited means, the burden of the support of the family partly devolved upon him and interfered with his cherished hope of completing a full course at college. Nevertheless, by close economy and by employing his vacations in teaching, he was enabled to spend two profitable years at Dartmouth College. At the end of this time, at the age of nineteen, he was obliged to lay aside his college studies for good, and accepted a teacher's position in the public schools at Dedham, Mass. Here his work was so acceptable that at the end of eighteen months he was invited to become the master of the Grammar School in Newton, a position which he accepted and filled to the utmost satisfaction for a period of six years. The reputation which he there acquired as a kind and judicious disciplinarian and an accurate and thorough teacher procured him an invitation to the principalship of the High School in Somerville, Mass. Here he taught with the highest success for eight years, resigning his position in 1867 to come to Chicago. The fullness of his knowledge, together with his rare ability to impart it, his unostentatious dignity, kindness of heart and graciousness of manner, soon won him the respect and confidence of this community, and made the Chicago Academy, which he founded in 1867 and conducted until the close of

his life, one of the most successful private schools in the city. Moreover, his ripe scholarship and scientific knowledge soon made him a prominent factor in the intellectual activities of the city. He became closely identified with the work of the Chicago Academy of Sciences, being its president during the last four years of his life. He was also a prominent member, and, at one time, President of the Illinois State Microscopical Society, to whose publications he contributed several important scientific papers. It was in *The Lens*, the organ of this Society, that he published his valuable notes on the "Flora of Chicago and Vicinity."

Professor Babcock's ability as a botanist was thoroughly appreciated by his co-laborers in the same science. His knowledge of the subject was extensive, varied and accurate. He was not only well acquainted with our own flora, but had a wide general knowledge of botany besides. As a collector and observer he was indefatigable, and he corresponded and exchanged extensively both with home and foreign botanists. His herbarium specimens, always prepared with the most scrupulous neatness and care, have enriched many collections both in America and abroad. The letters from famous botanists received in acknowledgment of specimens sent by him, frequently allude in most complimentary terms to the careful preparation of his specimens. He had, moreover, unusual skill in the use of the microscope, and his knowledge of the minute structure of plants was extensive and thorough. To those who were acquainted with his attainments, but not thoroughly so with the modesty of the man, it was a source of wonder that there was such a wide gap between what he knew and what he published. He was at the opposite extreme from that class who, with half knowledge, rush into print. He shrank from publicity and was too conscientious to publish anything except as the result of the most patient and thorough investigation. He was besides a devoted and busy teacher, and was burdened not only with the management of a large school, but much of the time also with other enterprises that made large demands upon his time and attention. In this connection should be mentioned his relations to the unfortunate Chicago Botanical Garden. In 1874 this enterprise was started under the auspices of the South Park Commission, and very naturally Professor Babcock's prominence and recognized ability as a botanist led to his selection for the directorship of the garden. He immediately resigned his lectureship in the College of Pharmacy and entered upon his new work with characteristic energy and zeal. Mr. H. W. S. Cleveland, at that time the landscape gardener of the park, says of him: "Mr. Babcock entered at once upon the active duties of preparation and surprised me by the display of such executive power as I had rarely met with in men not engaged in the active pursuits of life. He was confined to his school so continuously as to leave him but little leisure, yet he found time to inform himself thoroughly of all the latest improvements in the construction and heating of plant houses, and a building was erected under his direction for the purpose, which might serve as a model of economy of form and adaptation to its object." With the advice and consent of the Board of Management he prepared a circular and sent to all the principal botanical gardens of the world and to prominent individual botanists, stating the plans of the management and soliciting contributions of seeds, cuttings, living plants, herbarium specimens, etc., for the gardens, and holding out the inducement that, in return for such contributions, suitable returns of native plants would be made at an early day. Responses to this circular were so cordial and generous and Professor Babcock's industry so indefatigable that in an astonishingly short time there had grown up in South Park a botanic garden which gave promise of rapidly taking

first place among enterprises of the kind in this country. It was creditable alike to the city and to science. Mr. Cleveland further says of Professor Babcock's industry at this time: "Every hour that he could secure from his school duties was devoted to the interests of the garden, and although Saturday was the only day of which he had full control, the amount of labor which he accomplished in collecting and arranging specimens and seeds and in conducting the extended correspondence which of necessity ensued, was such as to astonish all who were in position to observe it." His assistant, Mr. James Bowen, also says of him: "No man accomplished more in so short a time and at so small an expense." According to the records, at the end of the second year, Professor Babcock had sent to different botanic gardens upwards of 5,000 packages of seeds, plants and specimens, had received nearly 15,000, and had upwards of 6,000 species under cultivation in the garden.

But to the shame of the city, be it said, that she permitted a work so auspiciously begun to fall for lack of friendly support. She threw away the opportunity which was within her grasp of securing a distinction worthier than that of a mere center of wealth and business enterprise. In the autumn of 1877 the South Park Commissioners notified the Director and Managers that the garden would be discontinued. Here were the labor and the hope of years brought to naught; scientific treasures of inestimable value were wasted; faith with contributors was violated; the cause of science in Chicago was disgraced. Could anything more crushing than this happen to a sensitive nature like that of Professor Babcock? He was wont to say little about this, the great misfortune of his life, but he felt the disappointment most keenly, and there is little doubt that it had to do with the undermining of a constitution already somewhat impaired by close and long-continued application to study. His death occurred about four years after, on the 7th of November, 1881.

GEOLOGY OF COOK COUNTY, ILLINOIS.

It is proposed to give, in this article, only so much of the geology of the region covered by the Catalogue, as may have some bearing upon its flora. Plants have very definite relations to soils and soils have a geological origin. The introduction and sometimes the extinction of species of plants in any locality may be due to geological causes, such as the presence of salt or fresh water, to currents in the adjacent waters, to climatic and dynamical changes which have taken place in the locality. The flora of every locality has had a history, and it is the duty of the botanist to read that history if possible.

The flora of this region presents some problems which can be satisfactorily solved only by reference to geological history. These problems are presented by the presence of such plants as the Beach Pea, the Beach Plum and the Sea-side Crowfoot.

The presence of pines and several herbaceous plants at the south end of Lake Michigan which do not exist on the middle portions of its shores but only at its northern part, suggests transportation by currents and a deposition of seeds with the great amount of material which has been torn from the sides of the lake, and piled in ridges on the southern shore.

The territory under discussion lies to the south and west of the head of Lake Michigan. The map given covers most of Cook County, Illinois, and some

of Lake County, Indiana. It represents the drainage of the region, and by its division into townships and square miles, will enable the student to locate quite definitely, any phenomenon under consideration. The four townships in the northwest of Cook County, not represented on the map, are drained into Fox river, which runs nearly parallel to the Desplaines, and about twenty-five miles to the west of it.

The location of the beaches as indicated by lines, to be described, is taken from Dr. Edmund Andrews; and the arrows indicating the direction of the striae on the rocks, are taken from Mr. Ossian Guthrie, a civil engineer of Chicago, who has had much observation in this vicinity.

From north to south between the Desplaines river and the north and south branches of the Chicago river, runs the remarkably low divide between the basin of the Mississippi and that of the Great Lakes, or the St. Lawrence. This divide in its lowest part, is not more than twelve feet above the lake. It is so low that in times of high water, the Desplaines overflows the divide, and its surface waters run into Lake Michigan.

The towns Rich and Bloom in the south part of the county, which do not appear on the map, belong to the lake basin, and are drained northward into the Calumet. The northern portion of Lake County, Indiana, which is considered in the botanical area discussed, is also drained by the Grand Calumet. Near the south end of the lake are five small lakes lying in Cook County, and in Lake County, Indiana. The names of these lakes are, Calumet, Hyde, Wolf, Lake George and Berry Lake. These are connected by sluggish bayous with each other and with the Calumet river and Lake Michigan. The largest of these lakes is the Calumet, which is about three miles long. The greatest diameter of each of these five small lakes, is north and south, parallel to the greatest diameter of Lake Michigan itself. For the most part, the area outside of the lake basin has a black prairie soil with woodlands along the streams. Within the lake basin, there is a clay surface upon which are sand and gravel ridges covered with oaks, and between which are swamps and beds of peat.

The mean altitude of Lake Michigan above mean tide at New York for thirty-five years is 581.28. † It is generally, however, placed at 582 feet. The Chicago datum which was fixed in 1847 is 1.65 feet below the mean altitude of the lake. Altitudes in the vicinity of Chicago are usually reckoned from this datum. The highest point of land within the city limits rises only twenty-five feet. The altitude of the general surface of the northern part of the county, may be inferred from the altitude of the four stations on the Chicago and Northwestern Railroad given below. Glencoe, on the Milwaukee branch, on the lake shore near the northern line of the county, has an altitude of 93.7 feet. Lake Forest, eight miles northward, 122.8 feet. Palatine, on the Janesville branch, 170.6 feet, and Barrington, at the northern limit of the county, 249.9 feet. The whole surface of the county rises northward. And again south of the city, it rises towards the southern margin of the county. The southern margin of the lake basin where the Wabash R. R. crosses it, has an altitude of 130 feet. The M. S. & L. S. R. R. crosses it at 260 feet, and the Illinois Central at 205 feet. But most of the land between the sand ridges lying south and east of Chicago around the small lakes and along the Calumet river, is but very little above the

† See "Professional Papers" Corps of U. S. Engineers, No. 24, Comstock.

level of Lake Michigan. The solid rock beneath this region is shown by artesian-well borings to be about as follows:—

Niagara Limestone.....	254 feet
Hudson river (Cincinnati)	250 feet
Trenton Limestone	330 feet
St. Peter's Sandstone.....	155 feet
Lower Magnesian.....	70 feet

1059 feet.

The culminating axis of elevation of these lower rocks, which is in Wisconsin in the vicinity of Madison and Devil's Lake, is 700 to 850 feet above the lake. The St. Peter's Sandstone is the source of the waters which come to the surface through artesian wells. The waters of the first well that was bored in Chicago, which was in the vicinity of Western Avenue, rose to about 55 feet above the lake. The pressure which elevates the water, comes from the head in the distant elevations of the rock, in Wisconsin.

The surface rock in the northwestern part of the State of Illinois, is the Trenton (Galena) Limestone, which dips under the more recent rocks to the east and south. Detached particles of the Hudson river shales are found in the "Mounds," and higher points overlying the Galena Limestone, in the northwestern portion of the State, but only the Niagara comes to the surface, in a broad strip along the western shore of the lake, from Milwaukee, southward to the southern part of Cook County. The lower beds of the Niagara are fine grained, buff colored, magnesian limestone, extensively quarried at Lemont, and very extensively used for building purposes in Chicago and vicinity. It is evenly bedded and easily worked.

The upper beds, which alone appear at the surface in the region under consideration, are a gray, siliceous limestone. It is hard and not easily wrought into dimension stones, but it is made into lime and much used for road making. About forty feet of the upper portion within the limits of Chicago, contains large quantities of bitumen. Some of these beds are very rich in fossils. These have interested palæontologists for several years past. Besides the species common to the Niagara in other places, many peculiar species have been described from this locality, showing that in these ancient seas, this area, which is now Chicago, had a fauna distinctly its own. Speaking in a general way, these rocks have a dip of from five to ten degrees towards the southeast or south; but there have been local disturbances, as at Stony Island, where the dip is as great as thirty-five degrees. Northward the rock does not appear at the surface outside the city limits. West and southwest of the city, it is near the surface over large areas, and is quarried in many places.

It rises about twenty-five feet above the lake within the city at Western Avenue, and in the bluffs on the sides of the Desplaines at Lamont these rocks are found more than sixty feet above the lake. This part of the basin of Lake Michigan is scooped out of the Niagara rock.

Wherever the clay has protected the surface of the rock from action of the atmospheric agencies, glaciated surfaces are nicely preserved. They are now found planed and grooved precisely as the glaciers left them. The direction of these striæ, is west of south, as indicated by the arrows upon the map. The arrows at Cheltenham Beach and those just north of the mouth of the Chicago river indicate the direction of the striæ beneath the clay. Those along the canal feeder, whose direction is almost at right angles to that of the others, are placed there on the authority of Mr. Ossian Guthrie. We have not ourselves seen them, and cannot judge what may be the legitimate inferences from them.

The boulder clay, which lies over the solid rock, has great thickness beneath the waters of the lake, and on the shore of the lake northward at Glencoe, it rises 75 feet above the surface of the water. This clay is irregularly bedded, but in a general way three layers may be distinguished; first and lowest, a quicksand; second, "permeable" boulder clay well stratified; third, "wet" boulder clay obscurely stratified. In this last bed, the tunnels for obtaining water for the city have been excavated.

In the vicinity of Michigan City, Indiana, a boring has shown the bed rock to be about 300 feet below the surface of the lake, covered with 143 feet of quicksand, the boulder clay lying over the quicksand. The clay contains small angular boulders, which are frequently glaciated. The upper part contains pockets of gravel the origin of which has been much discussed. One hypothesis is that the gravel now forming the pocket, was a frozen mass at the time of the deposit, and that it has behaved as a rock would have done under the circumstances, and become imbedded in the clay. The other suggestion is that the gravel was washed from the surface of the glacier into crevasses or wells by the surface waters and formed into a conical pile which became covered with finer sediment. In the section of the bluff at Evanston, represented in figure 2, above the shingle of the lake shore is seen a vertical section of clay. The black point in the diagram of the clay, represents one of these gravel pockets as it was observed. It was fifteen inches in diameter, and extended four feet nearly horizontally in the clay. The laminae of the clay were contorted, and seemed to have the pocket of gravel for an axis.

It is in the fragments of Devonian shales contained in these upper clays, that occur the macrospores of *Protosalvinia chicagoensis* discovered and described by B. W. Thomas and Dr. H. A. Johnson.

In the northern part of the country the clay lies very thick over the rock, but in the region immediately about Chicago excepting lakeward, it varies from none at all to a few feet in thickness. The clay at the surface is usually covered with a few inches and sometimes a foot or two of mould and soil, and in level areas and slight valleys, it is covered with swamp and peat.

Blue Island ridge and the "Sag Timber Hills" marked B and C on the map, is a mass of boulder drift lying above the blue clay. It is composed of large boulders, coarse gravel, and sand imperfectly stratified. Blue Island station at the foot of this ridge is 22 feet above Chicago datum, but the highest point in Blue Island Village which is near it and upon the ridge is 62.5 feet above datum. The highest point on the ridge is 89.2 feet. The surface of the "Timber Hills" is very undulating. The highest point is near the western margin, and is 140 feet above datum. There is a detached mass lying south of the canal feeder called Lane's Island with a small lake on its top. Similar hills of drift exist at Lombard just beyond the margin of the county.

Chicago occupies a part of an ancient bay of Lake Michigan. At the time the bay existed, there was an outlet of the lake in the southwest part of the county through what is now the Des Plaines river. The margin of this ancient bay is now marked by shore lines, or beaches. There are three distinct beaches marking three distinct stages in the waters of the lake. They may be designated as the Upper beach, the Middle beach and the Lower beach. The Upper beach is the older, the Middle beach the next in age and the Lower beach is a recent beach. The altitude of the Upper beach, which is the farthest from the lake, is about 55 feet above the lake, or six hundred thirty-seven feet above the seat. The water line of the Middle beach is about thirty feet above the lake. The Re-

cent beach lies upon the shore, and is not usually more than thirty feet high, but at Michigan City, Ind., the hills of blown sand, which form a part of this Recent ridge, are one hundred and sixty feet high. The Upper beach begins on the lake shore at the village of Winnetka, in New Trier, and running southwest it strikes the Desplaines river at Riverside, about eleven miles from the lake. Between this village and the Summit Station on the south side of the river, is an ancient outlet of the lake through which the waters ran by way of the Desplaines and Illinois rivers finally into the Gulf of Mexico. The Upper beach continues down the north side of the river till it passes out of the county. South of the river, the Upper beach surrounds a large area of unmodified drift which was an island when the bay and the outlet existed. South of the island was another ancient outlet which united with the first westward of the island at a place near the river now called "The Sag." The Upper beach, marking the south shore of the bay and outlet, comes into the county on the south side of the Desplaines river, on the west line of the town of Lemont, and continues east and southward and passes out of the county into the State of Indiana near Lansing, on the Chicago and St. Louis R. R. The Middle beach begins on the shore of the lake near the north line of Evanston, and runs southward within the Upper beach and at a distance from it of four miles at the north end, to very near to it at the Village of Riverside, where it disappears. From Summit Station on the south side of the Desplaines river, it runs eastward and southward around the small lakes. South of the small lakes, it becomes divided into many minor ridges, and in this form it passes into Indiana. The Recent beach begins on the University grounds in Evanston and keeps near the lake. From Douglas Park it sends a branch down to Englewood, and at South Chicago it divides into many minor ridges. Some of the minor ridges lie between the smaller lakes. In this divided state, it passes eastward into Indiana along the south shore of the lake. These beaches were extensively discussed by Dr. Edmund Andrews many years ago, but the disastrous fire of 1871 left no copies of his work in the city. Dr. Andrews found that the mass of the Recent (Lower) beach, was almost exactly equal to the sum of the masses of the other two beaches. From this conclusion was drawn that the time of the formation of the Recent beach has been longer than the time of the formation of either of the other beaches.

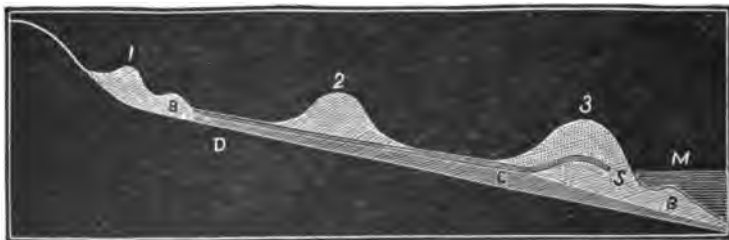


Fig. 1.

Fig. 1 is a diagram of a cross section of these beaches borrowed from Dr. Andrews, in which M, represents Lake Michigan; D, boulder clay; 1, Upper beach, B, sub-aqueous bar of the Upper beach; 2, Middle beach; 3, Recent beach, B, a sub-aqueous bar of the Recent beach; S, old soil found in the Lower beach and running under the Middle beach; C, clayey deposit of the same age as the Upper beach.

It is probable that the species of plants now existing in this area, have become indigenous since about the time of the formation of the Upper beach. We

do not know the history of this period sufficiently in detail to affirm it to be a fact that all species have come to the locality within this time, but there are some facts which suggest the hypothesis. The wood found under the drift in other

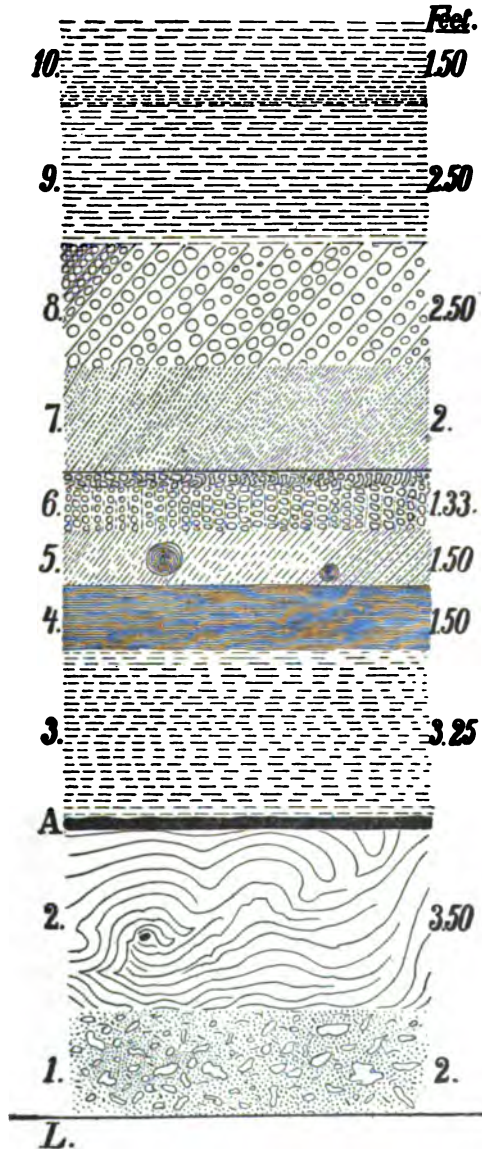


Fig. 2.

parts of the State, does not belong to the species now growing in the localities in which it is found, and so far as determined, the woods found under these beaches differ from the woods growing upon them at the present time.

Figure 2 represents a section of the Lower beach taken at its terminus on the University Campus in Evanston in 1864.

For ten years previous to that time, according to the best information that could be obtained, the shore had washed away about two rods each year. At the time the section was made, a northeast storm had produced a clear vertical section of the bluff. L, indicates the water surface. For two feet at the foot of the bluff, the shingle of the shore covered the clay. Above the shingle was a vertical section of the upper portion of the clay; three and one-half feet as shown in the diagram. At A, on the surface of the clay, five and one-half feet above the water, was an old soil. The layer of organic matter was very thin, but on it, was much coniferous wood, some of which appeared to grow on the place where it was found. No other kind of wood was found at that horizon. Three and a half feet of nearly horizontally stratified sand covered this soil. Then at 4, in the diagram, there was one and a half feet of peat. In the upper surface of the peat, were many fresh water shells. Nine different genera were identified, all of which were existing species. They were *Planorbis*, *Valvata*, *Physa*, *Lymnaea*, etc., with fresh water bivalves, so decomposed that it was impossible to determine the species. Upon this peat and lying more closely upon it than is indicated in the figure at 5, were trunks of oak trees in a layer of fine sand. This layer, 4, with the oak trunks lying on it or in it, extends under all the Village of Evanston east of the railroad. It is the same layer that is seen in Fig. 1 at S, and runs under the Middle beach but not under the Upper beach. At 6, Fig. 2, was a bed of coarser gravel in which were found in 1863, a little distance from the place of this section, pelvic bones which have been referred to the deer.

The parts of the section above this are of beach or bar structure and need no particular description. Specimens of the coniferous wood from the soil A, and of the oak from 5, were sent, in 1890, to Prof. D. P. Penhallow, of McGill University, Montreal, who on examination microscopically replies, "No. 1 is not an *Arbor Vita*, but a *Picea*. Both this and the oak, cannot be referred to any modern species, though the former approaches *P. sitchensis*, and the latter *Q. falcata* and *Q. prinus*. For the present, I would not assign specific names. I will simply designate them as *Picea* 13 and *Quercus* 14."

The genus *Picea* (spruce) does not now grow within several hundred miles from the locality, and the species of oaks which are now found upon the surface of the ridges are neither *falcata* nor *prinus*. The indication is, that previous to the beginning of the Recent beach, a climate and flora prevailed like that in Alaska. Then when the peat began to form at the time as indicated by the peat layer at 4, the spruces had disappeared and a species of oaks had taken their place, and now these have disappeared and other oaks have replaced them. This lower soil in the section at A, lying upon the clay, indicates a time when the surface of the waters were as low relatively to the land at this place as now. Afterwards the waters rose as high as the Upper beach. After the Upper beach was formed, the waters subsided to the Middle beach, and again to the Recent beach. Spencer has traced the shore line of the old Lake Iroquois beneath Lake Michigan.* The coniferous wood probably grew before Lake Michigan was definitely formed.

The oak is not completely decayed, The outside wood of the trunks is spongy, but the central portions are tough and fibrous. Borer then as now, infested the trees.

*Am. Jour. Sci. Vol. 40, p. 447.

Horizon 5, just above the peat, marks the upper or later limit of the Mastodon. It was on this soil about six years ago that the bones of a Mastodon were found in Chicago, on the south side of Wicker Park near Milwaukee Avenue. They were covered with thirteen feet of silt, or as Dr. Andrews suggests, Loess. The bones consisting of part of a jaw, teeth, and parts of a few other bones, are now in the collection of the Chicago Academy. There is in the Museum of the College of Liberal Arts of the Northwestern University a fragment of fossil ivory received from the late James L. Milner, afterward connected with the U. S. Fish Commission, taken from a gravel pit excavated in the Middle beach in Evanston when the Milwaukee Branch of the C. & N. W. R. R. was constructed. From what level it was taken, is not now known. The pit appears to have been excavated to the clay, and the fossil was probably on the same stratum as that at Chicago.

There is no positive evidence that the waters of the lake were salt water at the time the Upper beach was deposited. No shells have been found in the beach by which the character of the waters could be determined, but the presence of sea shore plants now upon the lake shore, and the existence of the marine *Mysis* in the waters of the lake, indicate that at some time, salt water has existed where Lake Michigan now is. The old bay of the lake whose margins are marked by the Upper beach, left some silts on its bottom, and in these silts have been found fresh water unios. We have fragments of such shells taken from the silts at the corner of West Monroe and Morgan Streets in Chicago.

Between the Middle and Upper beaches in Evanston, is what is known as the "Wet" prairie. It lies about fourteen feet above the lake. Its surface is nearly a water level. It is two miles wide and ten miles long. The clay is just beneath the surface under the whole area, and before it was drained, it was covered with water during the wet portion of the year. Southeast of Chicago where the ridges are multiplied, the spaces between these ridges are narrow and covered with marshes and small ponds.

Though Cook County, Illinois, and Lake County, Indiana, have neither mountains nor valleys, no frowning cliffs nor rocky glens, they have an interesting geological history, the outcome of which is a very unique botanical area. The rolling prairies, the river bottoms, the sandy ridges, the lake shore, the drift clay and its ravines, the sloughs among the ridges at the south end of the lake, the peat bogs which are found in many places, the shallow ponds and sluggish streams, give a great variety of soil for native plants.

FOREST TREES.

The forest trees of our district are of great interest in illustrating the ability of prairies to support forest growths, as they contain a large variety of forms, many of which are widely distributed over North America.

The area embraced in this Catalogue is included in the fourth division of the Atlantic Region of forest trees, known as the "Deciduous Forests of the Mississippi Basin and the Atlantic Plain" (Sargent), for with few exceptions our trees are composed of deciduous species.

In the forest area specimens are found of nearly all the trees growing in the State, the wood, according to the Ninth Census Report, averaging from two to

five cords to the acre. Among our seventy-one species and varieties, the oaks, ashes and walnuts form the chief lumber trees, while the soil and climate join in supporting many introduced forms of ornamental trees. The Tulip tree (*Leriodendron tulipifera*, L.), Kentucky Coffee tree (*Gymnocladus canadensis*, Lam.), Honey Locust (*Gleditschia tricanthus*, L.), the catalpas and willows, with elms, maples and poplars are ornaments for streets, residences and parks. The most characteristic and abundant trees are the oaks, of which there are eleven species. The scarlet, white, red, bur and black oaks (*tinctoria*, Bartram) are the most common forms. The black (*nigra*, L.), laurel, scarlet, swamp white and swamp Spanish oaks are occasionally reported.

The ash trees, represented by the white, green, red and black, are only met with locally, while the five species of maples, with the exception of the sugar maple, are generally distributed. Hickories are plentiful in the woods, the tall cottonwoods being more closely associated with civilization. One tree not previously reported for this section and about which there has been much discussion, is the Beach Plum (*Prunus maritima*, Wang.). Its presence here has, however, been settled beyond all question by careful study of the species.

Of our willows, six are trees, which are generally distributed. Of the ten species of trees that cross the continent, five are found within our limits. Seven of the fifteen trees that are found at intervals from the Atlantic to the Pacific are counted among our flora, while the *Salix amygdaloides*, the only tree found throughout the whole region extending from the Southern Pacific to the Atlantic, is here included. The Hop-tree (*Ptelia trifoliata*, L.), is the only species of the genus found in the region, while the *Negundo aceroides*, Moench., is the sole representative of the genus of either the Atlantic or the Pacific regions.

PLANTS OF INTEREST.

Among the various forms recorded in this Catalogue, some merit special mention by reason of peculiarities in form or habit.

Prominent among these plants of interest are the so-called insectivorous plants. Under this enumeration are two species of *Drosera*, the *Sarracenia purpurea*, L., and the *Utricularias*. The latter grow in ditches and capture water insects and small fish in their pouch-like leaves.

Situated along the shore of Lake Michigan is a class of alien plants whose natural habitat is in the vicinity of salt water. Of these saline forms the Beach Plum has already been spoken of under the title of trees. All along the shore of the lake the bright flowers of the Beach Pea (*Lathyrus maritimus*, Bigelow) can be seen during the summer months lifting their heads above the sand, while among them at Evanston and also at Wolf Lake and Clarke, Ind., the Saltwort (*Salsola kali*, L.) is sparingly found. Leaving the lake shore for the more marshy districts inland, several parasitic forms are found. Under foot the corpse plant and cancer-root rear their pale forms above decaying vegetable matter on the roots of other plants, while three species of the Dodder twine their waxy stems around the stalks of the *Helianthus* and other species of *Compositæ*. Occasionally exceptional forms, such as albinos, flowers differing in color from the characteristic hue and double forms, are recorded. A number of albino forms are included, among which may be mentioned the Cranesbill, Red Clover, Columbine,

Blazing Star, etc. Many double forms, among the species of *Hellanthus*, *Coreopsis*, etc., have been found in all stages of development.

No distinct paragraph has been given to rare plants, as they could not be enumerated in this connection, but they are designated in the text.

DISAPPEARANCE OF SPECIES.

While catalogues and check lists are necessary to record the constant introduction of new species into our floral community, they are no less useful for writing obituaries of forms that have become extinct.

Included among the species that are seemingly exterminated are: *Viola canadensis*, L.; *Desmodium marilandicum*, F. Boott.; *Pirus americana*, D C.; *Trisetum angustifolium*, L.; *Eclipta alba*, Hassk.; *Rhododendron nudiflorum*, Torr.; *Datura tatula*, L.; *Myrica cerifera*, L.; *Triglochin palustris*, L.; *Carex vulgaris*, Fries.; *Juniperus sabina*, L., Var. *procumbens*, Ph.; *Azolla caroliniana*, Willd.

LOCALITIES OF SPECIAL INTEREST.

There are certain areas in Cook County, Illinois, and Lake County, Indiana, which are of special interest to the botanist, because of the plants, which, in some instances, are found in them only. Prominent among the districts selected is the Calumet Region, embracing the territory drained by the series of lakes situated in the southern portion of Hyde Park township and that portion of Indiana adjacent to it. In this locality many rare forms of aquatic and bog plants are found, as well as several other species which are confined to Lake County, Indiana. Of the former class may be mentioned many of the *Potamogetons*, the *Orchids*, *Utricularias*, *Junci* and *Xyris flexuosa*, Muhl, while of the latter, numbering over ninety species, are the *Pyrola rotundifolia*, L., *P. rotundifolia*, L., Var. *asarifolia*, Hook, and *P. secunda*, L.; *Triglochin palustris*, L.; *Cypripedium acaule*, Ait., and *Carex richardsoni*, R. Br.

From this district some of the rare forms not recorded in the fifth edition of Gray's Manual, were obtained, such as *Gaura parviflora*, Dougl., and *Potamogeton fluitans*, Both.

The only specimen of the *Typha angustifolia*, L., reported in the northern part of Cook County was found in a swamp called the "Skokie," situated west of Glencoe. Unfortunately for collectors, this interesting spot has been drained and the wild forms so numerous in years past have given place to fields of wheat and corn.

Another locality which merits notice is the strip of heavily timbered country extending through the central and northern portions of Cook County, and locally known as the "Big Woods." Here many of our representative trees are found as well as less frequent forms, while around their trunks twine the wild grape, woodbine, bitter-sweet and poison ivy. In the spring parts of this area are submerged and marshy, and abound with species of the *Trillium*, *Arabis* and *Cardamine*. Species of the *Habenaria*, *Cypripedium* and *Orchis* are here met with, as well as the *Sanguinaria canadensis*, L., and *Oxalis violacea*, L. During the summer and autumn the undergrowth is marked by species of *Solidago*, *Aster*, *Hellanthus*, *Eupatorium*, *Urtica*, *Pilea* and many others, while the fallen logs present a great variety of mosses and fungi.

On the edge of the prairie, in South Evanston, is a small field made prominent by reason of the fact that it is the only spot in Illinois from which the *Lycopodium inundatum*, L., has been reported. The plants grow in moist prairie soil and occupy an area of several square yards. Associated with the *Lycopodium* is the *Drosera rotundifolia*, L., *Pogonia ophioglossoides*, Nutt., *Calopogon pulchellus*, R. Br., and several rare species of *Polygonum*.

The lake shore at Evanston has been previously noticed in connection with the *Salsola kali*, L.; *Polenasia* and *Arctostaphylos* also grow there. This area is too extensive to treat exhaustively, but is interesting because of the wide range of species found growing in the sand and on the bluffs.

Probably the most unique feature of our district is the chain of ravines, in the bluffs, from Lakeside northward. In these ravines the plants characteristic of prairie soil, dry and moist woods, swamps and sandy areas, are found grouped together. The beautiful *Cypripedium spectabile*, Swartz., the *Hepatica*, the *Sanwdort* and many *Compositæ* find here conditions favorable to their development.

Stony Island and Hog Island are also localities of great botanical interest, furnishing many species seldom met with elsewhere. Recent improvements have, however, changed the floral aspect of the area. Hog Island is situated about one mile southeast of Grand Crossing and is intersected by Stony Island avenue, about two blocks south of the C., Ft. W. & P. R. R. It is from three to five feet higher than the surrounding low prairie, and consists of about twenty acres. Stony Island is situated about one mile to the south. The flora of both localities has been exceedingly varied. The platting of the former into building lots and the improvements incident thereto, have caused a material change in the flora and the extermination of some of the rarer forms, such as *Hydrastis canadensis*, L.; *Trillium cernuum*, L.; *Cypripedium spectabile*, Swartz., *pubescens*, Willd., and *parviflorum*, Salisb.

STATISTICS OF THE CATALOGUE.

In order to simplify and to more clearly set forth the facts in the composition of our Flora, the following tables are presented. By means of these tables we shall attempt to give an analysis of the larger groups and orders and to compare them with the statistics of other floras. The enumeration is made to include the species and varieties, both being numbered in the catalogue, with the exception of those in the appendix, 14 in number. The total number of plants recorded and numbered is 1322, distributed among 113 families and 488 genera, and may be grouped as follows:

1. Native species.....	1033	
2. Introduced species.....	177	
Total number of species.....		1210
3. Native varieties.....	107	
4. Introduced varieties.....	5	
Total varieties.....		112
Total species and varieties.....		1322
5. Additions from appendix 1, genera 2— Species and varieties.....		14
Final total.....		1336

SYSTEMATIC DISTRIBUTION.*

The systematic distribution of these forms is set forth in the following table:

	Families.	Genera.	Species.	Varieties
Polypetalæ	43	162	371	27
Gamopetalæ	26	158	393	38
Total Dichlamydeæ	69	320	764	65
Monochlamydeæ (Apetalæ)	19	46	114	8
Total Dicotyledons	88	366	878	73
Monocotyledons	1	103	299	34
Gymnosperms	1	4	6	1
Total Phænogamia	107	473	1183	108
Vascular Cryptogamia	6	15	28	3
Totals of the Flora	113	488	1211	111

LARGE FAMILIES.

In the table given below, the 19 largest families are arranged according to the number of species and varieties, no family having less than 15 species being included:

	Genera.	Species.	Varieties
Compositæ	51	170	19
Cyperacæ	11	97	19
Gramineæ	37	85	5
Leguminosæ	22	53	2
Rosacæ	12	44	5
Ranunculacæ	14	33	5
Scrophulariacæ	16	33	3
Labiatæ	20	33	1
Cruciferæ	12	32	2
Liliacæ	14	29	
Orchidacæ	11	28	1
Umbelliferæ	21	24	3
Polygonacæ	4	24	2
Caryophyllacæ	7	23	
Salicacæ	2	19	5
Cupuliferæ	7	19	
Ericacæ	9	17	4
Naiadacæ	5	17	2
Onagracæ	5	15	2
Caprifoliacæ	6	15	
Totals	286	810	80

The total number of orders being 113, it will be seen that the 19 enumerated, or 17 per cent., represent 59 per cent. of the genera and 68 per cent. of the species and varieties.

*Species and varieties of the appendix are not included in any of the following tables.

LARGE GENERA.

The 18 largest genera selected are those having 8 or more species, and are arranged according to the number of species and varieties.

	Species.	Varieties
Carex	55	15
Aster	27	4
Solidago	20	4
Polygonum	15	2
Salix	14	5
Helianthus	14	2
Viola	13	2
Potamogeton	12	2
Ranunculus	12	2
Juncus	11	5
Cyperus	11	1
Panicum	11	1
Asclepias	10	1
Habenaria	10	1
Desmodium	10	
Hypericum	9	1
Quercus	9	
Galium	8	2

Less than 4 per cent. of the 488 genera contains 321 species and varieties, or 24 per cent. of the entire number.

COMPARISONS WITH OTHER FLORAS.

For the purpose of showing the numerical relation which exists between the plant life of the territory represented by this Catalogue, and other localities approximating to its area, the total number of species and varieties of their phænogamia are given as follows:

	S. and Var.
Flora of Cook County, Illinois, and Lake County, Indiana.....	1291
Flora of Essex County.....	1257
The Cayuga Flora.....	1278
Plants of Oneida County.....	1390
Flora of Washington and Vicinity.....	1211

In order to bring out some interesting facts with regard to the relation of our flora to the vegetable life of different sections of the United States, the plan laid down by Ward, in his *Flora of Washington and Vicinity*, has been followed to some extent. In the Flora referred to, comparisons are made between its systematic distribution, orders, genera and species, and those of the Eastern United States. As a "final statistical exhibit, more comprehensive in its scope," Mr. Ward gives a table in which the divisions are reduced to a common standard, which is done by taking the percentage which each division bears to the total of the flora specified. By following this method, the rank of each group is obtained relative to those of the several floras compared. (See fifth and sixth tables.)

The areas taken into consideration are:

1. Flora of Cook County, Illinois, and Lake County, Indiana.
2. Illinois State Report (Patterson).
3. Flora of the Northeastern United States.
4. Flora of the Southeastern United States.
5. Flora of the Eastern United States.
6. Plants collected by the 40th parallel survey.
7. Plants collected by Lieutenant Wheeler's survey.

As Mr. Ward states, the last two are introduced rather as a means of contrasting the eastern with the western portions of the continent than as a proper part of the comparative botanical statistics of the vicinity.

The first four of the following tables form a comparison between our flora and that of the Eastern United States, showing the percentage of the former to the latter. Prominence is given to this section of the country, as it includes our district.

COMPARISON OF DIVISIONS.

	Eastern U. S. Species and Varieties	Cook and Lake Co's Species and Varieties	Percentages.
Polypetalæ.....	1115	398	36
Gamopetalæ.....	1314	431	33
Total Dichlamydeæ....	2429	829	35
Monochlamydeæ (Apetalæ)	349	122	35
Total Dicotyledons.....	2778	951	34
Monocotyledons.....	1034	333	32
Gymnosperms.....	28	7	25
Total Phænogamia.....	3840	1291	34
Cryptogamia.....	194	31	16
Totals.....	4034	1322	33

The total number of species and varieties included in the Eastern United States is 4034, of which the 1322 plants of our flora form 33 per cent.

COMPARISON OF FAMILIES.

In the following table only such families are selected as have 26 or more species:

	Eastern U. S., Species and Varieties	Cook and Lake Co's Species and Varieties	Percentages.
Compositæ.....	497	189	38
Cyperaceæ.....	357	116	32
Gramineæ.....	297	90	30
Leguminosæ.....	208	55	26
Rosaceæ.....	104	49	47
Ranunculaceæ.....	80	38	48
Scrophulariaceæ.....	97	36	37
Labiata.....	121	34	28
Crucifera.....	76	34	45
Liliaceæ.....	82	29	35
Orchidaceæ.....	71	29	40
Umbellifera.....	63	27	43
Polygonaceæ.....	56	26	46

COMPARISON OF GENERA.

	Eastern U. S. Genera.	Cook and Lake Co's Genera.	Percentages
Polypetalæ.....	340	162	48
Gamopetalæ.....	379	158	42
Total Dichlamydeæ.....	719	320	45
Monochlamydeæ (Apetalæ)	97	46	47
Total Dicotyledons....	816	366	46
Monocotyledons.....	198	103	53
Gymnosperma.....	12	4	33
Total Phanogamia.....	1026	473	46
Cryptogamia.....	39	15	38
Totals.....	1065	488	46

The total number of genera in the first area is 1065; that of the second 488, or 46 per cent.

COMPARISON OF SPECIES.

In the following table the twelve largest genera are compared:

	Eastern U. S. Species.	Cook and Lake Co's. Species.	Percentages.
Carex.....	180	70	39
Aster.....	63	31	49
Solidago.....	61	24	39
Polygonum.....	27	17	63
Salix.....	23	19	83
Helianthus.....	27	16	59
Viola.....	24	15	63
Ranunculus.....	27	14	52
Juncus.....	38	16	42
Cyperus.....	41	12	29
Panicum.....	36	12	33
Asclepias.....	22	11	50

Here the genus *Salix* is the best represented, *Viola* ranking second. Seven reach 50 per cent. or more.

PERCENTAGE COMPARISON OF DIVISIONS.

The following table shows the relation of our flora to the floras specified:

	Cook and Lake Counties.	Illinois.	Northeastern United States.	Southeastern United States.	Eastern United States.	Fortieth Parallel Survey.	Wheeler's Survey.
Polypetalæ.....	30.1	28.5	26.8	28.9	27.6	35.1	31.9
Gamopetalæ.....	32.6	32.2	31.6	34.7	32.6	36.0	35.8
Total Dichlamydeæ.....	62.7	60.7	58.4	63.6	60.2	71.1	67.7
Monochlamydeæ (Apetalæ).....	9.3	9.8	7.9	8.8	8.7	9.8	10.6
Total Dicotyledons.....	72.	70.5	66.3	72.4	68.9	80.9	78.3
Monocotyledons.....	25.2	25.5	29.	24.3	25.6	16.4	15.7
Gymnosperms.....	0.5	0.7	0.9	0.7	0.7	1.2	1.3
Total Phænogamia.....	97.7	96.7	96.2	97.4	95.2	98.5	95.3
Cryptogamia.....	2.3	3.3	3.8	2.6	4.8	1.5	4.7
Totals.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PERCENTAGE COMPARISON OF LARGER FAMILIES.

	Cook and Lake Counties.	Illinois.	Northeastern United States.	Southeastern United States.	Eastern United States.	Fortieth Parallel Survey.	Wheeler's Survey.
Compositæ.....	14.3	13.	12.2	13.7	12.3	16.5	16.6
Cyperaceæ.....	8.7	8.5	10.5	8.	8.9	4.4	3.8
Gramineæ.....	6.8	7.8	7.5	7.2	7.4	5.4	7.8
Leguminosæ.....	4.2	4.7	4.3	6.1	5.2	7.3	8.3
Rosaceæ.....	3.7	3.2	3.	2.2	2.6	3.4	2.9
Ranunculaceæ.....	2.9	2.7	2.3	1.9	2.	3.	2.3
Scrophulariaceæ.....	2.7	2.7	2.3	2.5	2.4	4.5	4.8
Labiatae.....	2.6	2.8	2.2	2.8	3.	0.9	2.2
Cruciferae.....	2.6	2.1	2.	1.4	1.9	4.4	2.8
Liliaceæ.....	2.2	2.1	2.4	2.1	2.	3.	1.5
Orchidaceæ.....	2.2	1.8	2.4	1.9	1.7	0.6	0.5
Umbelliferae.....	2.	1.8	1.7	1.6	1.6	2.4	1.3
Polygonaceæ.....	2.	1.8	1.1	1.5	1.5	4.	3.2

PART I.

PHÆNOGAMIA.

RANUNCULACEÆ.

CLEMATIS, L.

1. **C. virginiana, L.** Common Virgin's Bower. Virginian Clematis. Banks of streams in rich soil; infrequent. July—September. Desplaines river, near Maywood. Pine Station, Ind., *Dodgs.* Burnside, *Brennan.*

ANEMONE, Tourn.

2. **A. patens, L., var. nuttalliana, Gray.** Pasque-flower. May-flower. Pulsatilla. Prairie Smoke. Prairie Anemone. Easter-flower.

A. nuttalliana, D. C.

Pulsatilla patens, Gray.

A few specimens have been found on the banks of ravines, in dry, sandy soil, in the northwestern part of our district, near Palatine. April—May. (B.)

A less hairy form with white petals is occasionally found elsewhere, and may be looked for within the limits of our flora. This species is usually found in patches.

3. **A. CAROLINIANA, Walt.** Carolina Anemone.

Prairies; rare. May—June. (B.)

Evanston. Near Lake Calumet, on the banks of the C. R. I. & P. R. R.

The sepals vary from white to pale purple. Probably introduced from the West. *Rhizome tuberous.*

4. **A. cylindrica, Gray.** Long-fruited Anemone.

Sandy soil; not common. June 15th—July.

The sepals of two specimens found near Evanston were pink. A monstrous specimen was collected near South Chicago, with the fruiting receptacle $2\frac{1}{2}$ inches long.

5. **A. virginiana, L.** Virginian Anemone.

Moist prairies and banks of streams; not rare, sometimes abundant. July—August.

6. **A. pennsylvanica**, L. Round-leaved Anemone. Pennsylvanian Anemone.

Prairies, rich meadows and banks of streams; frequent. July—August.

A more stunted form is found on sandy bluffs and knolls.

7. **A. nemorosa**, L. Wood Anemone. Wood-flower. May-flower.

Woods and meadows, in rich soil; very abundant. April—May.

Often hairy.

8. **A. nemorosa**, L., var. **quinquefolia**, Gray. Five-leaved Wind-flower.

With the last; common, often more common than the type.

Usually hairy. (B. P.)

9. **A. hepatica**, L. Hepatica. Liver-leaf. Round-lobed Hepatica. May-flower. Herb Trinity.

Hepatica triloba, Chaix.

Dry banks and ravines; infrequent, except locally (Winnetka, Glen-coe). April—May. Near Blue Island, Brennan. (B.)

Rare or infrequent throughout the southern part of the district.

Specimens were collected near Riverside, with pistils and stamens changed to sepals.

10. **A. acutiloba**, Lawson. Sharp-lobed Hepatica. May-flower.

Hepatica acutiloba, D C.

Hepatica triloba, Chaix, var. *acuta*, Ph.

In similar localities with the last, but more common, especially southward. April—May.

It seems to be a more hardy species than *A. hepatica*, L., often occupying the whole of the north side of a ridge, while the *A. hepatica* is found only on the south. The number of sepals varies from 6 to 14. The flowers are seldom entirely white. On a specimen found near Woodlawn the middle lobe of all the leaves was symmetrically tri-lobed and the lateral ones bi-lobed. Specimens with the leaves unequally five-lobed are not infrequent.

A form is occasionally found which "has a three-lobed leaf subtending the involucre, the involucreal leaf in its axis completely divided into two, smaller than the remaining two of the whorl," Hill.

ANEMONELLA, Spach.

11. **A. thalictroides**, Spach. Rue-Anemone.

Thalictrum anemonoides, Michx.

Anemone thalictroides, L.

Moist woods with *Anemone nemorosa*, L., which it resembles; common. April—May.

Two specimens found near Niles had the sepals three-lobed; often the flowers are doubled, and there may be two or more rows of sepals. Specimens with all the stamens and pistils undeveloped or changed to sepals are occasionally found. Specimens from Niles are usually pinkish, and those with pink and white flowers are not uncommon elsewhere.

Leaves whorled at base of peduncles, Washington Heights, *Dodge*.

THALICTRUM, Tourn.

12. *T. dioicum*, L. Early Meadow Rue.

Woods, banks, and fence rows; common. May.

18. *T. polygamum*, Muhl. Tall Meadow Rue.

T. cornuti, in Manual, 5th Ed.

Wet prairies and banks of streams; infrequent or rare. June—September.

Specimens found near South Chicago measured 11 feet in height.

The average height is about 5 feet.

14. *T. purpurascens*, L. Purplish Meadow Rue.

T. cornuti, L., var. *purpurascens*, Wood.

Including var. *ceriferum*, Austin.

Dry and usually sandy soil; frequent. May—June.

In some seasons the staminate form is far more abundant than the pistillate.

In woods near Whiting, Ind., a form with the following characteristics is found: Polygamous; intermediate between *T. purpurascens* and *T. cornuti*; filaments white; stamens at first drooping but little; anthers mucronate; 8 to 5 feet high, *Hill*.

MYOSURUS, Dill.

15. *M. minimus*, L. Mouse-tail.

Prairies; rare.

Evanston, July, 1886. (B.)

RANUNCULUS, Tourn.

16. *R. circinatus*, Sibth. Stiff Water Crowfoot.

R. divaricatus, in Manual, 5th Ed.

R. aquatilis, L., var. *stagnatilis*, DC.

South Chicago; rare. June, 1883, 1884, 1886.

Streams near Lake Calumet; rare, 1885.

Sheffield, Ind.; frequent. (B.)

17. *R. aquatilis*, L., var. *trichophyllus*, Gray. Common Water Crowfoot.

Aquatic; common locally. May 15—July 10.

Hyde Park and south. North branch of the Chicago river. Rogers Park, *Johnson!* Riverside, *Bastin!*

18. *R. cymbalaria*, Ph. Seaside Crowfoot.

Moist, sandy soil. May.

Frequent from Hyde Park, south and west. Ravenswood. Evanston.

Petioles 2 to 5 inches long.

19. *R. multifidus*, Ph. Yellow Water Crowfoot.

Usually aquatic; common. May—June 15.

Sometimes turns white with age.

Creeping in sandy mud, Hammond, Ind., *Hill*.

20. *R. multifidus*, Ph., var. *terrestris*, Gray.

Prairies; rare. June—July.

Rogers Park. South Chicago. Near Woodlawn.

21. *R. abortivus*, L. Small-flowered Crowfoot.

Rich soil, usually in open moist woods; common. April—July 15th.

22. *R. sceleratus*, L. Cursed Crowfoot.

Swamps and ditches; frequent. May 20th—July. (B.)

Evanston. Niles. South Chicago. Englewood and southeast.

The juice of this species is so acrid that it will often cause blisters to form upon the skin of the collector.

23. *R. recurvatus*, Poir. Hooked Crowfoot.

Rich woods; frequent, rather local. May—June. (B.)

In dry places it is usually less hairy.

24. *R. fascicularis*, Muhl. Early Crowfoot. Buttercup. Cowslip.

Sandy soil; abundant. April—May, often as late as August.

A few specimens found at Glencoe bore white flowers. Plants occasionally 1 to 2 feet high. The roots vary from slender to quite fleshy.

25. *R. septentrionalis*, Poir. Crowfoot.

R. repens in Manual, 5th Ed., mainly.

Moist woods and prairies; common. May—June, often as late as September.

A very variable species.

26. *R. REPENS*, L. Creeping Crowfoot.

A few specimens were collected in a low place near Maywood, July, 1889. (B.)

The leaves were spotted and slightly pubescent; styles stigmatic along inner margins; low, some plants creeping, and rooting at the nodes. We do not believe that the species is indigenous at this point.

27. **R. pennsylvanicus**, L. f. Bristly Crowfoot.
Wet places and open woods; infrequent, but distributed throughout the district. June 15th—July 25th. (B.)
28. **R. bulbosus**, L. Buttercup. Tall Buttercup. Bulbous Crowfoot. Fields, probably introduced in grass seed; rare. June—July. (B. P.) Kenwood. Evanston. South Evanston. Niles, *Miss Belle Alling*. Pullman, *Brennan*.
29. **R. acris**, L. Tall Crowfoot. Buttercup.
Fields; not common. (B.)
Evanston, 1885. Kensington, 1879, *Brennan*. Englewood, 1880, *Hill*.
2 to 5 feet in height.

ISOPYRUM, L.

30. **I. biternatum**, T. & G. False Rue-Anemone.
Moist grounds.
Evanston. Lake View. Jefferson. South Chicago. Hyde Park, *Brennan*. Maywood, *Herman Jaeger*. Banks of north branch Chicago river, from west of Ravenswood to North Evanston, *Mason Bros*.
Easily mistaken for *Anemonella thalictroides*, Michx.

CALTHA, L.

31. **C. palustris**, L. Marsh Marigold. Cowslip. Gools.
Swamps; common, often abundant. April—May.
In wet but not boggy localities the flowers are often larger than ordinary specimens; the average measurement of several flowers being from $1\frac{1}{4}$ to 2 inches.

COPTIS, Salisb.

32. **C. trifolia**, Salisb. Coptis. Goldthread.
Wet and boggy, shaded places, or rich woods; very rare. May. (B. P.)
Berry Lake, Ind., 1887. Pine Station, Ind., 1887—88.

AQUILEGIA, Tourn.

33. **A. canadensis**, L. Wild Columbine. Honeysuckle.
Woods and roadsides; not common. May—June.
North Evanston and southward. Usually more frequent along the tracks of railroads from the east.
Two specimens nearly white were found near Lakeside.

DELPHINIUM, Tourn.

84. **D. azureum**, Michx. Azure Larkspur.
Fields; rare. June—July. (B.)
Hyde Park. Rogers Park. Englewood, *Dodge*.

CIMICIFUGA, L.

85. **R. racemosa**, Nutt. Black Snakeroot.
Pine Station, Ind., *Brennan*. (B.)

ACTÆA, L.

86. **A. spicata**, L., var. *rubra*, Ait. Red Baneberry. Red Cohosh.
Rich and rather open woods; not rare. May—June 15. (B.)
87. **A. alba**, Bigel. White Baneberry. White Cohosh.
A. spicata, L., var. *alba*, Michx.
Moist woods and shaded banks; not common. May 10th—June.
Occasional specimens with white berries and slender pedicels are found.

HYDRASTIS, Ellis.

88. **H. canadensis**, L. Orange-root. Yellow Puccoon. Tumeric-root.
Yellow-root.
Rich and wet soil; very rare.
South Chicago. Hinsdale, *Mason Bros*. Hog Island, 1876 and
1886, *Brennan*. Rose Hill, *Johnson*. (B.)

MAGNOLIACEÆ.**LIRIODENDRON**, L.

89. **L. tulipifera**, L. Tulip-Tree. White or yellow poplar.
Rich woods. Whiting, Indiana, May 25th—June 10th, *Hill*! (B.)

MENISPERMACEÆ.**MENISPERMUM**, L.

- 40 **M. canadense**, L. Canadian moonseed.
Ditches and banks; not common. June—July.

BERBERIDACEÆ.**CAULOPHYLLUM**, Michx.

41. **C. thalictroides**, Michx. Blue Cohosh. Pappoose-root.
Moist woods; not common. April—May.
Niles. Glencoe. Hyde Park and south.

PODOPHYLLUM, L.

42. *P. peltatum*, L. Podophyllum. May-apple. Mandrake. Devil's Apples.

Moist woods; common, or abundant. May—June.

NYMPHÆACEÆ.**BRASENIA, Schreb.**

43. *B. peltata*, Ph. Water-shield.

Aquatic; not common. June—July.

Rose Hill. South Chicago. Pine Station, Indiana, *Bastin*.

NELUMBO, Tourn.

44. *N. lutea*, Pers. Yellow Nelumbo. Water Chinquepin.

Nelumbium luteum, Willd.

Aquatic. July.

Foot of Lake Calumet and Calumet river. Wolf Lake, *Babcock*!

CASTALIA, Salisb.

45. *C. odorata*, Greene. Sweet or Sweet-scented Water-lily.

Nymphæa odorata, Ait.

Aquatic; infrequent, or rare. June—September. (P.)

North Branch Near Palatine. Berry Lake, Ind.

Flowers 4 to 7 inches in diameter, and sweet-scented.

46. *C. tuberosa*, Greene. Tuberous Water-lily.

Nymphæa tuberosa, Paine.

N. raniformis, D C.

Aquatic; common or abundant. July—September.

The flowers are very large in many of the unfrequented and grassy sloughs of Northern Indiana. It is more common than the last, with which it is often confounded:

In the examination of over one hundred plants, the flowers of which were over seven inches in diameter, and the petals very obtuse and broad, the rhizomes bore the easily detached simple or compound tubers. Flowers large; 5 to 9 inches in diameter, quite or nearly odorless and white.

NYMPHÆA, L.

47. *N. advena*, Solander. Common Yellow Pond-Lily. Spatter-dock.

Nuphar advena, Ait.

Still water and stagnant pools; very common. July—September.

48. *N. advena*, Solander, var. *variegatum*, Engelm.

A few specimens near South Chicago.

Flowers variegated with purple or pink. The number of rays of the stigma varies from 10 to 24. (B. P.)

SARRACENIACEÆ.**SARRACENIA**, Tourn.

49. **S. purpurea**, L. Side-Saddle-flower. Water Pitcher. Huntsman's Cup.
Swamps. May—July.
Rogers Park. Cassella, Indiana, and south to limits; frequent.

PAPAVERACEÆ.**SANGUINARIA**, Dill.

50. **S. canadensis**, L. Blood-root. Blood-wort. Red-root.
Moist rich woods; frequent. April—May.
Niles. Glencoe. Evanston. Palatine. Riverside. South Chicago, and southward. Washington Heights, *Williams*. Elsewhere seemingly rare.

STYLOPHORUM, Nutt.

51. **S. diphyllum**, Nutt. Celandine Poppy.
Damp rich woods; infrequent. May. (B.)
Berry Lake and Pine Station, Indiana. Miller's, Indiana, near Calumet River.

NOTE.—*Papaver somniferum*, L., has been noted at Evanston and Hyde Park, where it had seemingly escaped cultivation. As it is not persistent, however, it cannot be included in our Flora.

Two or three specimens of *Eschscholtzia californica* have been reported growing on the University Campus at Evanston, where they had evidently escaped from cultivation. The *Argemone mexicana*, L., is frequently met with but is not sufficiently persistent to rank among the species of our Flora.

FUMARIACEÆ.**ADLUMIA**, Raf.

52. **A. cirrhosa**, Raf. Climbing Fumatory.
Egondale. Near Lincoln Park, Chicago, *Babcock*.
Probably introduced.

DICENTRA, Borkh.

53. **D. cucullaria**, D C. Dutchman's Breeches.
Woods; not common. April 20th—May.
Evanston. Rose Hill. North Branch. Riverside, *Bastin*. Englewood and Forest Hill, *Brennan*. Washington Heights, *Williams*. Flowers tinged with pink, Stony Island, *Hill*! Very rarely, plants are found with pale blue flowers.
54. **D. canadensis**, D C.
Rich moist woods of the Calumet Region and southward; rare. May.
Forest Hill, *Brennan*.

CORYDALIS*, Vent.55. **C. glauca**, Ph. Pale Corydalis.

Evanston. Stony Island, a single specimen May 25th, 1887. Forest Hill, *Brennan*. (B.)

56. **C. aurea**, Willd. Golden Corydalis.

A single specimen, found near the I. C. R. R. near Calumet, *Babcock*.

FUMARIA, Tourn.57. **F. officinalis**, L. Common Fumitory.

Evanston and South Park, July 15th, 1885. (B. P.)

Probably introduced with other seeds at both these locations.

CRUCIFERÆ.**DENTARIA**,† Tourn.58. **D. laciniata**, Muhl. Toothwort. Pepper-root.

Wet woods and banks of streams; not common. April—June 10th.

A few specimens with alternate, long-petioled leaves were collected, near Woodlawn. Flowers usually purple.

CARDAMINE, Tourn.59. **C. rhomboidea**, D C. Spring Cress.

Swamps, wet prairies and banks of streams; common. March 25th—August.

Flowers usually white, sometimes purplish.

60. **C. rhomboidea**, D C., var. **purpurea**, Torr.

In richer soil than the type; common. March—May 15th.

Flowers pink or purple. Leaves quite variable.

Occasional specimens are found that are inclined to be weak and decumbent and possessing fibrous roots rather than tuber-bearing rhizomes. This would connect it with *C. rotundifolia*, Michx.

61. **pratensis**, L. Cuckoo Flower.

Calumet river, near Miller's, Indiana; rare, *Bastin & Hill* April. (B. P.)

62. **C. hirsuta**, L. Small Bitter Cress.

Swamps and low grounds; frequent. May—June. (B.)

Niles. Calumet Region. Riverside. Evanston. Winnetka, *Johnson*.

A form that is smooth and intermediate between the type and variety *sylvatica*, was found in dry woods at Highland Park, Lake Co., Illinois, *Hill*.

*The species of *Corydalis* are, apparently, easily exterminated, but often re-appear.

†We believe that *Dentaria* should be included under *Cardamine*, but as the marks of alliance are not always apparent to the student, it has been thought wise to retain the genus.

ARABIS, L. Rock Cress.**63. A. ludoviciana, Meyer.**

Sandy soil; rare. May—June.

Niles. Riverside, *Babcock*.**64. A. hirsuta, Scop.**

Sandy soil; infrequent. May—June. (B.)

Evanston. Hyde Park. Riverside, *Bastin*. Grand Crossing, *Hill*.**65. A. lævigata, Poir. Smooth Rock Cress.**

Prairies; not common. May—June.

Evanston, infrequent. Riverside, *Babcock*. Riverdale, *Bastin*!Highland Park, Lake Co., Illinois, *Hill*. Rosedale, *Brennan*.**66. A. canadensis, L. Sickie Pod.**South Chicago, July, 1875, *Dodge*; 1870, *Hill*. (B.)**67. A. perfoliata, Lam. Tower Mustard.***Turritis glabra, L.*

A single specimen was found near L. S. & M. S. R. R. depot, South Chicago, in 1887. (B.)

Chicago, June 20th, 1875, *Babcock*, in *Herb. of Northwestern University*.Evanston, *Boltwood*. Lakeside, *Johnson*.**68. A. confinis, Watson. Drummond's Tower Mustard.***A. drummondii*, in *Manual*, 5th Ed.*Turritis stricta, Graham*.

Sandy soil; nowhere common. May—June. (B.)

Evanston. Quarry, near Crawford, 1886, on C. B. & Q. R. R. Northern Illinois, *Vasey*,—*Gray's Manual*, 5th Ed., p. 69.**69. A. lyrata, L.**

Sandy soil; frequent. April—May.

Evanston and vicinity. Hyde Park and southward. Riverside. Palatine.

70. A. dentata, T. & G.Riverside, *Babcock*.**DRABA, Dill.****71. D. caroliniana, Walt. Whitloe Grass.**

Sandy fields; frequent. March—May.

Evanston. Calumet. South of Calumet, *Babcock*. University Campus, Chicago, *Bastin*.Leaves often toothed. Petals emarginate, Stony Island, *Hill*!Petals wanting in later racemes, Englewood, *Hill*.

72. *D. CUNEIFOLIA*, Nutt. Whitloe Grass.
Chicago, April, 1875, *Babcock*, in *Northwestern University Herbarium*.
Probably a waif. (B. P.)
73. *D. VERA*, L. Whitloe Grass. Nailwort.
Sandy soil of the lake shore; rare. May-July. (B. P.)
South Evanston. Ten or a dozen specimens were collected in this
locality in 1882; few, if any, being found from that time until
1886, when several were exhibited by students of the Northwestern
University.
- ALYSSUM**, Tourn.
74. *A. MARITIMUM*, L. Sweet Alyssum.
Occasionally found near gardens, from which it has escaped. (B. P.)
75. *A. CALYGINUM*, L. Alyssum.
Evanston. Near Garfield Park, Chicago, where it had evidently
escaped cultivation. At Woodlawn and Morgan Park, it has been
reported as growing spontaneously. (B. P.)
- CAMELINA**, Crantz.
76. *C. SATIVA*, Crantz. False Flax.
Near Evanston, *Boltwood*, *Johnson*! (B. P.)
- NASTURTIUM**, R. Br.
77. *N. OFFICINALE*, R. Br. True Cress.
Brooks and ditches; not common. June-July.
Local throughout the district.
78. *N. palustre*, D C. Marsh Cress.
Swamp; not common. June-Aug. (B.)
Niles. South Chicago. Calumet Region.
Pods usually ovoid to elliptical, rarely oblong.
79. *N. palustre*, D C., var. *hispidum*, Gray.
Wet places; infrequent. June-July. (B. P.)
Hyde Park and south.
80. *N. lacustre*, Gray. Lake Cress.
Aquatic; rare. July. (B.)
South Chicago. South branch Chicago river, 1875-87, *Bastin*.
81. *N. ARMORACIA*, Fries. Horseradish.
Moist grounds, an escape from cultivation; infrequent.
- SISYMBRIUM**, Tourn.
82. *S. CANESCENS*, Nutt. Tansy Mustard.
Near Miller's, Indiana.
Hegewisch, Indiana, *Hill*. (B.)

88. *S. OFFICINALE*, Scop. Hedge mustard.
Cultivated fields; infrequent. May—Aug. (B.)

BRASSICA, Tourn.

84. *B. SINAPISTRUM*, Bois. Charlock. Field Mustard.

Sinapis arvensis, L.

Fields; infrequent. May—August. (B.)

85. *B. NIGRA*, Koch. Black Mustard. Scurvy.

Sinapis nigra, L.

Roadsides, cultivated grounds and waste places; infrequent. July—Aug. (B.)

CAPSELLA, Medic.

86. *C. BURSA-PASTORIS*, Moench. Shepherd's Purse. Toy Wort. Pick-purse.

Abundant. April—September.

This is one of the few cosmopolitan plants that flourish alike amid Alpine snows and the high temperature of the equator.

LEPIDIUM, Turn.

87. *L. virginicum*, L. Wild Pepper-grass.

Roadsides and fields, in sandy soil; frequent. June—Aug.

Sometimes continues in flower until the middle of November.

88. *L. intermedium*, Gray. Pepper-grass.

Dry fields, and sandy prairies; common. July—Aug.

89. *L. CAMPESTRE*, R. Br. Pepper-grass.

Evanston, 1886. Colehour, Ind., 1888. Englewood, near C. P. & Ft. W. R. R., 1880, *Hill*. (B. P.)

90. *L. SATIVUM*, L. Pepper-grass.

Spontaneous in ditches at Englewood, July, *Hill*. (B. P.)

CAKILE, Tourn.

91. *C. Americana*, Nutt. American Sea Rocket.

Sandy soil; not common. June—Sept.

Lake shore, both north and south of Chicago.

CAPPARIDACEÆ.

POLENASIA, Raf.

92. *P. graveolens*, Raf. Heavy-scented Polenasia.

Near the lake shore; not frequent. July—Aug.

East of Woodlawn, *Bastin*. Normal Park, *Brennan*. Englewood, *Hill*. Evanston.

OLEOME, L.

98. *C. INTEGRIFOLIA*, T. & G.

Sparingly, escaped from cultivation at Chicago, *Monros*.

As it is not eaten by domestic animals, this pretty plant will probably become a roadside weed, *Patterson*, in *Plants of Illinois*. (B.)

OISTACEÆ.

HELIANTHEMUM, Tourn.

94. *H. canadense*, Michx. Frost Weed. Rock Rose.

Dry fields and fence rows; common. June—July.

Ravenswood. Woodlawn. Riverside. Desplaines. Englewood and eastward.

The hoary variety is frequent, and usually found on sunny hill-sides.

HUDSONIA, L.

95. *H. tomentosa*, Nutt. *Hudsonia*.

Pine Station and Miller's, Ind., 1889. Miller's, Ind., July, 1878, *Bastin, Dodge*. Along the ridge of sand bordering the Calumet valley from Tolleston to Miller's, Ind., *Hill*!

LECHEA, L. Pinweed, (arranged by Prof. E. J. Hill.)

96. *L. major*, Michx.

Frequent along the margins of sandy woods, especially dryer margins of woods surrounding sloughs in pine barrens. June—Sept.

Englewood. Hyde Park and southeast in Indiana.

97. *L. thymifolia*, Michx.

L. novæ-cæsaræ, Austin (Fide Herb., W. H. Leggett.)

Not uncommon in open sandy ground at Clarke, Tolleston and Miller's, Ind. August—October. (B. P.)

Usually in damper situations than *L. major*. An Eastern form, with no other known stations reported west of the Alleghanies. Once seen in flower, Sept. 16th, 1882. Petals 8, elliptic, dark red to purple, paler at base. Stigmas white plumose. A very pretty species when seen in full bloom, covered with numerous flowers. This is rare, as the flowers last but a short time, and apparently open only in the full light of the sun, or about midday.

Rafinesque, *New Flora of North America*, Phila., 1836, states that the anthesis of the *Lecheas* is in the middle of the day; a statement confirmed in the above case.

98. *L. minor*, Lam.

Somewhat rare in sandy copses with about the same range as *L. thymifolia*. August—October. (B.)

I have always found it growing among low bushes, such as *Vaccinia*, *Gaylussacia*, *Pirus Arbutifolia*, etc., but not in open ground, comparatively free from other growths. The stem is quite smooth below, slender, single, or sometimes with one or two additional ones from the same root, few leaved; branches loose and spreading, radical shoots few, rather long and ascending; flowers few and more scattered than in the following variety, which has a noticeably different appearance. It is pronounced by Mr. Leggett, who has made a special study of the genus *Lechea*, the typical form described by Lamarch; imperfect specimens of which, indicating the same form, he had seen from the woody regions of Canada.

99. *L. minor*, Lam., var. *stricta*, (Leggett in Herb.)

The most common form. August—October. (B. P.)

Frequently met with in open sandy ground, especially near the border of woods, from Evanston, south and east, through the sandy region. Stems quite stout, often in clusters of 2 to 6 from the same root, densely leaved and branched; branches ascending or appressed, a little heavy, as well as the leaves, with a fine, close pubescence; shoots at the base of the stem, abundant, usually shorter than in the type, and forming a dense rosette, in late autumn. Flowers and fruit very abundant and closely clustered.

100. *L. maritima*, Leggett.

L. thymifolia, Ph., and Manual, 5th Ed. (Fide W. H. Leggett.)

L. minor, L., var. *maritima*, Gray.

Rare, Pine Station, Ind., August 12th, 1887, W. K. Higley.

Sandy, open ground, a single specimen without radical shoots, but agreeing in all essential points, as far as present, with specimens from the Coast States.

It may be looked for northward along the shore of the lake, as immature specimens of *Lechea* from Milwaukee are suspected to be of this species, and also from Buffalo, N. Y. (B. P.)

NOTE.—In gathering *Lechea*, specimens of Numbers 97, 98 and 99 should be obtained late in the season as well as when in flower. In case of *L. minor* and its variety, they are best just before the cold of winter sets in. The radical shoots, so characteristic of the different species, are then fully developed. These, except in *L. major* and partially so in *L. thymifolia*, have disappeared before the flowers of the following year appear, and only occur at the time of fruiting or later.

As two species of *Lechea* thought to be peculiar to the Atlantic Coast regions have now been found here, others may be sought for, particularly *L. racemolosa*, Michx., which grows in similar situations, and it would be well for local collectors to carefully note all forms, as the genus is a difficult one, and

unexpected finds may result. One more species occurs in the west, not far from our bounds, *L. tenuifolia*, Michx., which I gathered in 1871-73, in the sand barrens west of Kankakee, Ills., and of which I have received specimens from Mr. M. S. Bebb, from near Rockford, Ills. The known forms from the west are therefore five, and a variety so well marked as to be of specific rank in this locality.

VIOLACEÆ.

VIOLA, Tourn.

101. *V. pedata*, L. Bird-foot Violet.

Sandy woods and knolls; frequent but local. April—May.

Found in flower September 11th, 1886, near Evanston.

Prof. Hill reports the following forms:

- a. Petals large, pale, lilac-purple.
- b. Narrow petals, deep lilac-purple, smaller than a.
- c. Petals pale and whitish, smaller than a.

102. *V. pedata*, L., var. *bicolor*, Ph.

Hyde Park, a few rods east of Jackson Park, 1887. Hammond, Ind., 1886-88, *Hill*. (B.)

103. *V. pedatifida*, G. Don. Larkspur Violet

V. delphinifolia, Nutt.

Moist prairies; infrequent. May 15th—June. South Chicago. Englewood and vicinity. Riverside. North Evanston, *Johnson*. Hyde Park, *Brennan*.

"In cultivation, the leaves seem to revert to *V. cucullata*, Ait., *Babcock*. Apparently an extreme variety of *V. palmata*, *Bebb*,"—in *Plants of Illinois*.

104. *V. palmata*, L. Blue Violet. Hand-leaf Violet.

V. cucullata, Ait., var. *palmata*, Gray.

Either in dry or rather damp soil; common. May—July, occasionally in August or September. (B.)

The form with five and seven lobed leaves, has been found at Riverside, South Chicago and Desplaines.

Rarely, specimens are found with the flowers spurless and with only slightly irregular and naked petals.

A form at New Lenox, growing in damp, rich woods, is intermediate in character between this and *V. sagittata* and *V. delphinifolia*, *Hill*.

105. *V. cucullata*, Ait. Common Blue Violet.

V. palmata, L., var. *cucullata*, Gray.

Abundant everywhere.

Very variable, both in shape and size of the leaves and the size and color of the flowers. In 1883, specimens of the white-flowered

form were gathered from woods near Evanston and transplanted. White flowers have been produced each year since, the plants spreading over a large area. Prof. Bastin has also collected near Grand Crossing, what he considers a white variety.

Specimens with leaves 5 inches broad at Whiting, Indiana, *Dodge*.

106. *V. sagittata*, Ait. Arrow-leaved Violet. Blue Violet.

Moist and rich open woods; infrequent. May—June.

Mainly south. Somewhat variable in size and hairyness of the petals. Rarely apetalous. Rootstock seldom smooth.

107. *V. blanda*, Willd. Sweet White Violet.

Damp woods and ravines; not common, except locally. April—May. Frequent near Morgan Park and Woodlawn, Calumet Region south to limits.

It is more common in certain seasons than in others. In 1882 only a few specimens were found near Evanston, but from 1884 it has been common everywhere in the northern part of the County. Flowers often very large.

108. *V. lanceolata*, L. Lance-leaved Violet.

Wet places; infrequent, common only at one point near the north end of Lake Calumet. Found in considerable quantities on the Campus at Evanston. South Evanston. Grand Crossing. South Chicago, *Bastin*. Hyde Park, *Brennan*. Leaves with serratures tipped with reddish glands; serratures somewhat remote, *Miller's, Ind., Hill*.

109. *V. pubescens*, Ait. Downy Yellow Violet.

Damp places; common. May—June.

Specimens were collected in Wilmette, growing in moist woods, that measured from 12 to 14 inches in height.

110. *V. hastata*, Michx. Halberd-leaved Violet.

One-half mile southeast of Woodlawn, April 18th, 1878, *Bastin*. (B. P.)

111. *V. CANADENSIS*, L. Canada Violet.

Bank of L. S. & M. S. R. R., one mile south of Pine Station, Ind., June 25th, 1886.

This small group, consisting of three or four plants nearly two feet high and with white flowers, slightly tinged with blue, were evidently exterminated by workmen, as they were gone when looked for about the same time in 1887. Probably introduced from the east. (B. P.)

112. *V. striata*, Ait. Pale Violet.

Low grounds and moist woods, mainly southward; infrequent or rare. April 20—May, occasionally as late as August. (B.)

Evanston. Rogers Park. Wilmette. Cassella. Pine Station and Miller's, Indiana.

118. *V. rostrata*, Ph. Long-spurred Violet.

On shaded sand hills near Miller's, Indiana, May 28th, 1886. (B. P.)

114. *V. canina*, L., var. *muhlenbergii*, Gray. Dog Violet.

V. canina, L., var. *sylvestris*, Regel.

Wet shaded banks or fields; frequent and local. May—June.

Pine Station and Miller's, Indiana. Indian Ridge, near Whiting, Ind., Hill.

Some of the leaves two-lobed, South Chicago, Dodge.

115. *V. tricolor*, L. Pansy. Heart's Ease. Herb Trinity.

Niles woods; infrequent. May—Oct. (B)

CARYOPHYLLACEÆ.

SAPONARIA, L.

116. *S. officinalis*, L. Common Soapwort. Bouncing Bet.

Roadsides and old fields; frequent. June—Aug.

The double form seems to be more common in dryer soil. At Niles, Norwood Park and Desplaines the single-flowered form has been quite common.

117. *S. vaccaria*, L. Cow-herb.

Vaccaria vulgaris, Host.

Escaped from gardens, and has become spontaneous in several localities. July.

Whiting Ind., Hill.

SILENE, L.

118. *S. stellata*, Ait. Starry Campion. Catch-fly.

Open woods and shrubby fields; frequent. June—August 15th.

Quite common in the open woods in the southern part of our district.

119. *S. nivea*, Oth. Campion.

Infrequent; latter part of July.

Evanston. Niles. Riverside. Morgan Park. Woods south of Jackson Park.

120. *S. cucubalus*, Wibel. Bladder Campion.

S. inflata, Smith.

Roadsides near Evanston; infrequent. (B.)

121. *S. virginica*, L. Fire-pink. Catchfly.
Damp open woods; frequent. July.
Niles. Frequent in open woods from Whiting, Ind, south. Banks
of the Desplaines, abundant, *Babcock*. Riverside, *Bastin*.
122. *S. antirrhina*, L. Sleepy Catchfly. Snapdragon Catchfly.
Sandy soil, and dry waste places, often following lax cultivation.
Frequent south. June—August.
Evanston. Niles. Austin. Hyde Park. Calumet Region.
128. *S. NOCTIFLORA*, L. Night-flowering Catchfly.
Sparingly escaped from cultivated grounds. Occasionally found in
the woods at Niles. July—August. (B. P.)
Evanston, *Boltwood*.
An anomalous form with no stamens and with from 8 to 8 styles has
been noted in Wisconsin, and may be found here.

LYCHNIS, Tourn.

124. *L. VESPERTINA*, Sibth. Evening Lychnis.
Occasionally found in cultivated grounds. June—August. Evans-
ton. (B. P.)
125. *L. GITHAGO*, Lam. Corn-Cockle.

Agrostemma githago, L.

Usually in wheat fields; frequent. June—July.
Frequent along railroad banks where the seed has been dropped
from cars of grain. A form with pure white flowers is occasionally
found.

ARENARIA, L.

126. *A. SERPYLLIFOLIA*, L. Thyme-leaved Sandwort.
Occasionally found along the railroads from the east.
Hammond and Clarke, Indiana, July, 1886. South Chicago, 1888.
(B. P.)
127. *A. michauxii*, Hook. f. Strict Sandwort.
Alsine stricta, Michx.
Arenaria stricta, Michx.
Infrequent or rare, except in the southern part of our district. July.
Niles. South Evanston, *Boltwood*. Colehour, Miller's and Edge-
moor, Indiana. Pine Station, Indiana, abundant, *Babcock*!
128. *A. patula*, Michx. Sandwort.
Stony Island, July 20th, 1885.
Riverside, *Babcock*. Grand Crossing, July, 1878, *Bastin*.
Dry ground by quarry near 75th street, Hyde Park, 1884, *Hill*. (P.)

129. *A. lateriflora*, L. Showy Sandwort.

Shaded grounds near lake shore; infrequent, perhaps rare. April—June.

South Chicago. South Evanston. Glencoe and Ainsworth. *Babcock*.

STELLARIA, L.180. *S. MEDIA*, Smith. Common Chickweed.

Abundant in moist grounds; common on higher and dryer localities, where it is less luxuriant.

181. *S. pubera*, Michx. Great Chickweed.

River Park, June, 1878, *Bastin*. (B. P.)

182. *S. longifolia*, Muhl. Long-leaved Starwort or Stitchwort.

Fields and roadsides; common. June—August.

183. *S. longipes*, Goldie. Long-stalked Starwort.

Moist prairies. Morgan Park, May, 1878, *Hill*. Near Garfield Park, 1889. (B. P.)

184. *S. crassifolia*, Ehrh. Starwort.

South Chicago, May, 1877, *University of Chicago Herbarium*. (B.)

CERASTIUM, C.185. *C. viscosum*, L. Mouse-ear Chickweed.

C. vulgatum, L., in *Manual*, 5th Ed.

Fields and waste grassy places; frequent. May—June.

186. *C. vulgatum*, L. Larger Mouse-ear Chickweed.

C. viscosum, L., in *Manual*, 5th Ed.

Fields and waste places; more common than the last. May—June, occasionally as late as September.

187. *C. nutans*, Raf. Nodding Mouse-ear Chickweed.

Moist places; infrequent. May—August.

SPERGULA, L.188. *S. ARVENSIS*, L. Corn Spurrey.

Grain fields; rare.

Near Palatine and Desplaines. Evidently introduced with other seeds. (B. P.)

PORTULACACEÆ.**PORTULACA, Tourn.**189. *P. OLERACEA*, L. Common Purslane. Pusley.

Common and often abundant in cultivated and waste grounds. June—August, usually in July. (B.)

TALINUM, Adans.

- 140.
- T. teretifolium*
- , Ph. Talinum.

June 25th—August.

Sandy hills; Miller's, Tolleston, Pine Station and Gibson's, Indiana.

CLAYTONIA, Gronov.

- 141.
- C. virginica*
- , L. Narrow-leaved Spring Beauty.

Moist woods and low places; common, often abundant. April—May.

Flowers sometimes entirely white, especially in dry seasons.

- 142.
- C. caroliniana*
- , Michx. White-leaved Spring Beauty.

With the last, but not nearly as common. April—June.

HYPERICACEÆ.**HYPERICUM, Tourn.**

- 148.
- H. ascyron*
- , L. Great St. John's Wort.

H. pyramidatum, Ait.

Rare. July. (B.)

Lake Calumet. Banks of the Little Calumet, southeast of Blue Island. Banks of the Desplaines River, near Maywood, 1888.

Banks of Thorn Creek, near Thornton, Hill.

Rarely the lower leaves are slightly petioled.

- 144.
- H. kalmianum*
- , L. Kalm's St. John's Wort.

Sandy soil, mainly along the lake shore, both north and south; frequent. June—August, occasionally as late as October.

Apparently introduced with *Pinus strobus* at Normal Park on Halsted, near 69th St., where there is a small patch, Hill.

- 145.
- H. prolificum*
- , L. Shrubby St. John's Wort.

Moist shaded banks; infrequent or rare. July—August. (B.)

Lamont. Willow Springs. Wheeling. Palatine.

Leaves 2 to 4 inches long.

- 146.
- H. perforatum*
- , L. Common St. John's Wort.

Fields; frequent or common. June—August.

- 147.
- H. maculatum*
- , Walt. St. John's Wort.

H. corymbosum, Muhl.

Damp, open woods and prairies; frequent. July—August.

Petals with round or oval black or brownish dots.

- 148.
- H. mutilum*
- , L. Dwarf St. John's Wort.

Low prairies; common. July—September. (B.)

Specimens found near Whiting, Indiana, had the lower leaves quite connate.

149. *H. gymnanthum*, Engelm and Gray. St. John's Wort.*H. mutilum*, L., var. *gymnanthum*, Gray.

Low ground; infrequent. August—September. (B.)

South Chicago, *Hill*. Whiting, Indiana.150. *H. canadense*, L. Swamp St. John's Wort.

Wet, sandy soil; frequent. July—October.

Near the lake shore at Evanston. South Chicago and Calumet Region. Englewood. Miller's, Indiana.

Quite variable. There are one or two forms intermediate between the type and the following variety. Flowers occasionally orange colored.

151. *H. canadense*, L., var. *majus*, Gray.

Less common than the type.

From South Chicago and Englewood, south to limits. (B.)

152. *H. nudicaule*, Walt. Orange-grass. Pine-weed.*H. sarothra*, Michx.

Lake shore, both north and south; infrequent. June—August.

Evanston. South Chicago, south to limits. Englewood, *Dodge*.Hammond, Indiana, *Hill*.**ELODES**, Adans.153. *E. campanulata*, Ph. Marsh St. John's Wort.*E. virginica*, Nutt.

Frequent, especially in swamps near Lake Calumet and southeast. June—August.

MALVACEÆ.**MALVA**, L.154. *M. rotundifolia*, L. Common Mallow. Cheeses. Low Mallow.

Roadsides, gardens, waste places, etc.; common or abundant. May—October, usually in June or July.

Petals whitish, pale blue or pink, the latter color often in lines.

155. *M. sylvestris*, L. High Mallow.

Roadsides and gardens; not common. June—August or later. (B.)

156. *M. crispa*, L. Curled or Crisped Mallow.

Occasionally found near old gardens. Spontaneous. (B. P.)

157. *M. moschata*, L. Musk Mallow.

Occasionally spontaneous, near old gardens. (B. P.)

CALLIRHOE, Nutt.

- 158.
- C. triangulata*
- , Gray.
- Callirhoë*
- .

Sandy and prairie soil; infrequent or rare. July.

Niles. South Chicago. Englewood. Hyde Park. Palatine.
Graceland, *Babcock*!

Pubescence varies from slightly hairy to almost hirsute.

ABUTILON, Tourn.

- 159.
- A. AVICENNÆ*
- , Gaertn. Velvet Leaf. Indian Mallow. Cotton-weed.

Sparingly escaped from gardens into waste places; spontaneous.
June—July.**HIBISCUS**, L

- 160.
- H. moscheutos*
- , L. Swamp Rose Mallow.

Shores of ponds.

Whiting, Indiana, 1880, *Hill*. (B.)

- 161.
- H. militaris*
- , Cav. Halbert-leaved Rose Mallow.

Banks of the Desplaines river, near Maywood, *Munroe*! (B.)**TILIACEÆ.****TILIA**, Tourn.

- 162.
- T. americana*
- , L. Basswood. Whitewood. Lime-tree.

Rich woods and banks of streams; hardly common. May.

LINACEÆ.**LINUM**, Tourn.

- 163.
- L. virginianum*
- , L. Flax.

Dry, sandy woods; frequent. Last of July.

South Chicago, Grand Crossing, and south to limits; rare elsewhere.

- 164.
- L. sulcatum*
- , Riddell. Flax.

Found with the last; rare. July.

The styles may be free or somewhat united at the base.

- 165.
- L. USITATISSIMUM*
- , L. Common Flax.

Sparingly spontaneous in old, dry fields, and along railroads. June
—July. (P.)**GERANIACEÆ.****GERANIUM**, Tourn.

- 166.
- G. maculatum*
- , L. Wild Cranesbill.

Woods and fields; abundant. May—June, and occasionally in August.

Flowers sometimes white, but not from age. Variable in color.

Easily cultivated when potted.

167. **G. carolinianum**, L. Carolina Cranesbill.

Old fields and waste places; infrequent. May 15th—July.

Lake Forest, Lake Co., Illinois. Winnetka. Evanston. Hyde Park. Lincoln Park, *Babcock*. Clarke and Pine Station, Ind., *Bastin*/ Grand Crossing, *Dodge*.

Occasional specimens are found, that closely resemble *G. dissectum*, L. The seeds are globular, and strongly reticulated, or rarely simply ridged, with but few cross lines; petals slightly emarginate, about the size of *G. carolinianum*, L., which it closely resembles in other particulars. Seems to blossom later than the type.

FLORKEA, Willd.

168. **F. proserpinacoides**, Willd. False Mermaid.

Swamps; rare. April—May.

Niles. North branch of the Chicago river, *Babcock*, *Munros*. Riverside, 1878, *Bastin*.

Chesterton, Ind., in damp woods at the base of a hill: procumbent; grows with *Ranunculus recurvatus*, at a distance from any marsh or stream, *Hill*.

OXALIS, L.

169. **O. violacea**, L. Violet Wood Sorrel.

Moist woods and banks; not common, May—July 15th.

Niles. Calumet Region. Riverside. Desplaines. Barrington. From Englewood, southward.

170. **O. corniculata**, L., var. **stricta**, Sav.

O. stricta, L.

Fields and open woods; common, often abundant. June—September.

IMPATIENS, L.

171. **I. pallida**, Nutt. Pale Touch-me-not.

With the next, but in more shaded places; not frequent. July—Aug. Riverside. Chiefly south.

172. **I. fulva**, Nutt. Spotted Touch-me-not. Jewel-weed.

Ravines, ditches and moist places; frequent, but not widely distributed. July—September.

A form without spots is occasionally found.

RUTACEÆ.

XANTHOXYLUM, L.

178. **X. americanum**, Mill. Northern Prickly Ash.

Woods; not common. April—June 10th.

Calumet Region; rare. Banks of the Desplaines. Northwestern portion of the district.

PTELEA, L.**174. P. trifoliata, L. Hop-tree.**

Sandy soil; rare. June.

Lake shore, Lincoln Park to Rogers Park.

West bank of the Desplaines, north of Riverside, *Babcock*. Blue Island, *Dodge*.

ILICINEÆ.**ILEX, L.****175. I. verticillata, Gray. Black Alder. Winterberry.**

Prinos verticillata, L.

Swamps and wet places. May 20th—June.

From Pine Station, Indiana, south; infrequent. Berry Lake, Indiana; rare. Clarke, Indiana, *Hill*. Gibson's, Indiana; rare, *Babcock*.

Often 8 to 10 feet high.

176. I. GLABRA, Gray. Inkberry.

Miller's, Indiana; common, *Babcock*.

Babcock gives it on other authority than his own. We have not seen the plant within our limits, nor a specimen in *Babcock's* herbarium, and therefore cannot confirm this report. (P.)

NEMOPANTHES, Raf.**177. N. fascicularis, Raf. Mountain Holly.**

N. canadensis, D C.

Wet grounds, usually in woods; not rare. April 25th—May.

Miller's, Edgemoor, and Pine Station, Indiana.

CELASTRACEÆ.**CELASTRUS, L.****178. C. scandens, L. Wax-work. Climbing Bitter-sweet.**

Woods and fence rows; not common. May—June.

The pods open and display the seed about the latter part of September. A very ornamental twining shrub, quite easily cultivated.

EUONYMUS, Tourn.**179. E. atropurpureus, Jacq. Burning Bush. Waahoo.**

Open, rich woods; infrequent, also cultivated. May—June.

Riverside and northward.

180. E. americanus, L. Strawberry Bush.

Highland Park, Lake Co., Illinois. Desplaines to Palatine. Calumet Region, *Brennan*. Infrequent or rare.

181. *E. americanus*, L., var. *obovatus*, T. & G. Trailing Strawberry Bush.

Wet, rich, open woods, along streams or low lands; infrequent. June. Chiefly south.

RHAMNACEÆ.

RHAMNUS, Tourn.

182. *R. alnifolius*, L'Her. Alder-leaved Buckthorn.

Swamps near Lake Calumet. Edgemoor, Ind. Pine Station, Ind., Bastin, Hill. Infrequent elsewhere. (B.)

183. *R. lanceolata*, Ph. Buckthorn.

Chicago, Babcock—in *Herb. N. W. University*. Kensington, Brennan. (B.)

CEANOTHUS, L.

184. *C. americanus*, L. New Jersey Tea. Red-root. Mountain Sweet.

Open woods; frequent. July.

VITACEÆ.

VITIS, Tourn.

185. *V. æstivalis*, Michx. Summer Grape.

Woods and thickets; common. May—July. (B.)

186. *V. cordifolia*, Michx. Winter or Frost Grape.

Along streams; frequent. June.

187. *V. riparia*, Michx. Winter or Frost Grape.

V. cordifolia, Michx., var. *riparia*, Gray.

Woods and shaded banks; frequent. May—June. (B.)

AMPELOPSIS, Michx.

188. *A. quinquefolia*, Michx. Virginia Creeper. Woodbine. Five-leaved Ivy. American Ivy. Ivy.

Woods and old fence-rows; frequent. July.

Easily cultivated as an ornamental vine.

SAPINDACEÆ.

ACEB, Tourn.

189. *A. pennsylvanicum*, L. Striped Maple. Striped Dogwood. Moose-wood.

Grows in rich soil. May. (B.)

Woods near north end of Lake Calumet, 1885. Riverside, Babcock—in *Herb. N.W. Univ.*

But two specimens have been reported within our limits.

190. **A. saccharinum**, Wang. Sugar Maple. Hard or Rock Maple.
Rich and open woods; infrequent or rare south, more common
north. April—May.
191. **A. dasycarpum**, Ehrh. Soft, River, White or Silver Maple.
Damp woods, and banks of streams and lakes; frequent.
Very commonly cultivated as a shade tree.
192. **A. rubrum**, L. Red, Swamp or Soft Maple.
Swamps or wet woods; frequent north. April—May.
Used extensively as a shade or ornamental tree.

NEGUNDO, Moench.

193. **N. aceroides**, Moench. Ash-leaved Maple. Box-elder.
Banks of streams, lakes and moist open woods; not common.
April—May. (B.)
Evanston. Hog Island, *Brennan!* Englewood, *Williams.* Whiting,
Ind., *Brennan.*
Cultivated, to some extent, for ornamental purposes.

STAPHYLEA, L.

194. **S. trifolia**, L. American Bladder-nut.
Wet and rather dark woods; not rare. May—June 15th.
Hyde Park. Banks of the Desplaines River, *Babcock.* Northwest.

ANACARDIACEÆ.

RHUS, L.

195. **R. typhina**, L. Staghorn Sumach.
Sandy soil; not common. June—July. (B.)
Calumet Region. South Chicago and south, on sand ridges. In-
frequent or rare northward.
196. **R. glabra**, L. Smooth Sumach.
Fields, etc.; frequent. May—June.
197. **R. copallina**, L. Dwarf Sumach.
Probably infrequent, except locally.
A single clump has been noted near Summit. The leaflets were entire.
Calumet, 1886. Miller's and Gibson's, Ind., *Babcock!* Hog
Island, *Brennan.*
198. **R. venenata**, D C. Poison Sumach. Dog-wood. Poison Elder.
Swamps, especially south; not common. June—July.
Calumet, July, 1886. Miller's, Ind., north to South Chicago.
Graceland, *Babcock.* Hog Island, *Brennan.*

199. *R. toxicodendron*, L. Poison Ivy. Poison Oak.
 Everywhere common or abundant. May—June.
 When erect, from 1 to 4 feet high. The climbing form, stems of
 which are occasionally two inches in diameter, is much less
 common.
200. *R. canadensis*, Marsh. Fragrant Sumach.
R. aromatica, Ait.
 Lake shore; common. May—July.

POLYGALACEÆ.

- POLYGALA**, Tourn. Polygala. Milkwort. Indian Pink.
201. *P. paucifolia*, Willd. Fringed Polygala.
 Homewood and Cook Co., *Hill*,—in *Plants of Illinois*. (B.)
202. *P. polygama*, Walt. Pink Polygala.
 In sandy soil; not common. July—August 15th.
 Hyde Park, south and west. Pine Station and Miller's Ind.; fre-
 quent.
203. *P. senega*, L. Seneca Snake-root.
 Sandy fields and banks; frequent. May—June.
 Specimens nearly two feet high have been collected at Stony Island.
204. *P. incarnata*, L.
 A few specimens were found near Cheltenham Beach in July, 1886.
 Eggleston, Ind., 1885, *Hill*. (B.)
 Flowers pale rose color.
205. *P. sanguinea*, L. Purple Milkwort.
 Wet places, usually in sandy soil; not common. July—August 15th.
 Evanston. Glencoe. Chiefly Hyde Park and south. Riverside,
Bastin.
206. *P. cruciata*, L.
 Occasionally found along the lake shore in low sandy soil, especially
 near the sloughs, south. July.
 Asbury avenue, South Evanston, where it is associated with *Drosera*
rotundifolia, L., and *Lycopodium inundatum*, L.
 Found with white flowers, Hammond, Ind., *Hill*.
207. *P. verticillata*, L.
 Dry sandy soil, near the lake shore; frequent. Chiefly south.
 July—August.

LEGUMINOSÆ.**BAPTISIA**, Vent.

- 208.
- B. tinctoria*
- , R.Br. Wild Indigo.

Sandy soil, both north and south, near the lake shore; infrequent.
June—July.

- 209.
- B. leucophæa*
- , Nutt. Yellowish False Indigo.

Prairie soil and open copses; infrequent. West. May. (B.)

- 210.
- B. leucantha*
- , T. & G. White False Indigo.

Prairies; frequent or common. May—June.

LUPINUS, Tourn.

- 211.
- L. perennis*
- , L. Wild Lupine. Perennial Lupine.

Sandy soil; not common, except locally.

Evanston and vicinity. Throughout the southern part of our district. Occasionally plants are found with flowers entirely white.

The edible root is often called "Chinook Liquorice."

TRIFOLIUM, Tourn.

- 212.
- T. arvense*
- , L. Rabbit-foot or Stone Clover. Poverty Grass.

Is occasionally found in old fields. (B.)

- 213.
- T. pratense*
- , L. Red Clover.

Abundant. June—September. Flowers occasionally white.

- 214.
- T. reflexum*
- , L. Buffalo Clover.

Prairies; rare. July.

Calumet Region. Riverside, and North Branch of Chicago river,
Babcock.

- 215.
- T. stolonifeum*
- , Muhl. Running Buffalo Clover.

C. P. & Ft. R. R., near Casella, Ind., 1884. South Chicago, near
100th street, 1886, on the banks of the L. S. & M. S. R. R. In-
troduced from the east. (B.)

- 216.
- T. repens*
- , L. White Clover.

Fields and Roadsides; abundant. June—September.

- 217.
- T. hybridum*
- , L. Alsike Clover.

A few specimens have been found near lines of railroads from the
east. (B. P.)

MELILOTUS, Tourn.

- 218.
- M. officinalis*
- , Willd. Yellow Melilot.

Waste places, usually in alluvial soil; common. June—July. (B.)

- 219.
- M. alba*
- , Lam. Sweet Clover. White Melilot.

Roadsides, door-yards and fields, chiefly in alluvial soil; common,
often abundant. June—July.

MEDICAGO, Tourn.

- 220.
- M. LUPULINA*
- , L. Black Medick. Nonesuch.

Occasionally found in waste places and near gardens. May 20th—
June, (B. P.)

PSORALEA, L.

- 221.
- P. tenuiflora*
- , Ph. Scurvy Pea.

P. floribunda, Nutt.

Calumet Region. Egondale. Palatine, Babcock. Chicago, *University of Chicago Herb.*

AMORPHA, L.

- 222.
- A. canescens*
- , Nutt. Lead Plant. Wild Tea.

Dry prairies and banks; frequent. July—August.

- 223.
- A. fruticosa*
- , L. False Indigo. River Locust.

Banks; not common. June—July.

Hyde Park and vicinity. Northward.

PETALOSTEMON, Michx.

- 224.
- P. violaceus*
- , Michx. Purple Prairie Clover.

Dry prairies and railroad banks; common. June—July, often as late as September.

Along the lake shore, south of Whiting, Ind., a low form is frequent, the stem inclining to diffuse; flowers rose-purple or violet, rarely the calyx is softly pubescent and not hoary.

- 225.
- P. candidus*
- , Michx. White Prairie Clover.

Dry prairies, found with the last; frequent. July.

TEPHROSIA, Pers.

- 226.
- T. virginiana*
- , Pers. Goat's-Rue. Catgut.

Dry sandy soil; common. June—July.

South Chicago and south.

Odd leaflet sometimes mucronate, usually emarginate; stem branched; standard yellowish to greenish white; keel rose-color to white, blotched with rose-color, Pine Station, Ind., 1889.

ROBINIA, L.

- 227.
- R. PSEUDACACIA*
- , L. Common Locust. False Acacia.

Naturalized; frequent. June. (B.)

ASTRAGALUS, Tourn.

- 228.
- A. canadensis*
- , L. Milk Vetch.

Moist woods along streams and lakes; frequent. July.

Mainly in sandy soil along the lake shore.

Riverside. Maywood. Riverdale. Rogers Park. Thorn Creek and Thornton, Hill.

Forms with loose spikes are not infrequent.

DESMODIUM, Desv. Tick-trefoil.**229. D. nudiflorum**, D C.

Woods; frequent, north and west. June 20th—July.

A white-flowered form was collected at Glencoe and Arlington Heights.

230. D. acuminatum, D C.

Rich, moist woods, specially south; frequent or common. July.

231. D. pauciflorum, D C.

Near Chicago, *Munroe*, in *Plants of Illinois*. (B.)

232. D. rotundifolium, D C. Round-leaved Tick-trefoil. Trailing Tick-trefoil.

Chicago and Blue Island, 1875, *University of Chicago Herb*. (B.)

233. D. dillenii, Darl.

Open woods; frequent. July. (B.)

234. D. paniculatum, D C.

In open woods; frequent. July 15th—August. (B.)

South Chicago and south. Elsewhere less common.

235. D. canadense, D C.

Rich woods; frequent or common. August—September.

236. D. sessilifolium, T. & G.

Dry places and open woods; infrequent. August.

Hyde Park and south.

237. D. rigidum, D C.

Near Lake Calumet, August, 1885. Miller's, Pine Station and Clarke, Ind., on sand ridges, August 10th—28th. Hammond, Ind., *Hill*. (B.)

238. D. marilandicum, F. Boott.

Near Wolf Lake, Ind., rare, July, 1885. Not observed since. (B.)

LESPEDeza, Michx. Bush Clover.**239. L. procumbens**, Michx.

Includes *L. repens*, Barton.

Dry sandy soil; infrequent. August. (B.)

240. L. violacea, Pers.

Dry open woods and copses; usually in sandy soil. August.

Variable; the typical form is infrequent.

241. E. reticulata, Pers.

L. violacea, Pers., var. *angustifolia*, T. & G.

Sandy soil, chiefly from South Chicago, southeast; not rare. August. (B.)

242. *L. stuvei*, Nutt., var. *intermedia*, Watson.

L. violacea, Pers., var. *sessiliflora*, in Manual, 5th Ed.

Occurs with the last, especially south; infrequent. August—September. (B.)

Flowers rarely apetalous.

243. *L. polystachya*, Michx.

L. hirta, Ell.

Dry soil and ravines, north and west, infrequent; sandy soil, hill-sides and knolls, south; frequent. August—September. (B.)

244. *L. capitata*, Michx.

Sandy bluffs and fields, variable; frequent or common.

Evanston and north. Colehour, Pine Station, Miller's and Clarke, Indiana.

Prof. Hill reports two forms from Hammond, Ind.:

(a) Leaves silky, canescent, both sides.

(b) An occasional form intermediate between the type and *L. angustifolia*, Ell.

245. *L. angustifolia*, Ell.

L. capitata, Michx., var. *angustifolia*, Ph.

Possibly more common than the last, especially south. August.

VIOLA, Tourn.

246. *V. cracca*, L. Blue Vetch. Tufted Vetch.

Woods; rare. June—July.

Evanston. Niles. South Park. Morgan Park. Riverside. (B. P.)

247. *V. caroliniana*, Walt. Carolina or Pale Vetch.

Banks of streams and shaded places; common. May 20th—June.

Stems occasionally five, and in extreme cases seven feet long.

248. *V. americana*, Muhl. American or Purple Vetch.

Moist banks, woods and copses; frequent. May—June.

LATHYRUS, Tourn.

249. *L. maritimus*, Bigel. Beach Pea.

Near the lake shore, north and south; frequent. May 20th—July 15th.

250. *L. ochroleucus*, Hook. Pale Vetchling.

Railroad banks and shaded bluffs; frequent. June—July 10th

251. *L. venosus*, Muhl. Vetchling.

Open woods, copses and shaded banks; not common, but widely distributed. June—July.

Leaves variable in size.

252. *L. palustris*, L. Marsh Vetchling.

Moist places; frequent or common. June—July 15th.

253. *L. palustris*, L., var. *myrtifolius*, Gray.

Moist places; infrequent. May 20th—July.

South Chicago. Hyde Park. Sheffield, Pine Station and Hammond, Ind. Englewood, Hill.

APIOS, Boerhaave.

254. *A. tuberosa*, Moench. Ground Nut. Dakota Potato.

North and west, infrequent or rare: wet grounds of Calumet Region, and banks of streams, south; infrequent. August.

PHASEOLUS, Tourn.

255. *P. perennis*, Walt. Wild Bean. Kidney Bean.

Near the lake shore in copses; rare or infrequent. August.

Colehour, Ind., 1885. Sheffield, Ind., 1886. Pine Station, Ind., 1887.

Near Chicago, *University of Chicago Herb.* (B.)

STROPHOSTYLES, Ell.

256. *S. angulosa*, Ell. Wild Bean.

Phaseolus diversifolius, Pers., and *helvolus*, L.

Lake shore, both north and south; frequent. August.

257. *S. peduncularis*, Ell.

Phaseolus helvolus, of Manual, 5th Ed., not of L.

Lake shore. South Chicago and south, Babcock.

258. *S. pauciflorus*, Watson.

Phaseolus pauciflorus, Benth.

Calumet river, near Miller's, Ind.; rare, August, 1885-87. (B.)

AMPHICARPÆA, Ell.

259. *A. monoica*, Nutt. Hog Pea-nut.

Rich and open woods; frequent. August.

Flowers occasionally white.

CASSIA, Tourn.

260. *C. chamæcrista*, L. Partridge Pea.

Sandy soil; frequent. August.

Chiefly in the southern portions of our district.

GYMNOCLADUS, Lam.

261. *G. canadensis*, Lam. Kentucky Coffee-tree.

June.

Two specimens have been noted in the woods at Niles. Desplaines river, north of Riverside, Babcock. South Park, July, 1886.

A very pretty ornamental tree. The wood is hard, and the grain is very regular. Seldom attains a diameter of more than 4 to 5 inches. The compound leaves are often 8 feet or more in length.

GLEDITSCHIA, L.

262. *G. TRIACANTHOS, L.* Honey Locust. Three-thorned Acacia.

Cultivated for ornament, and sparingly escaped in places. West.
(B.)

ROSACEÆ.

PRUNUS, Tourn.

263. *P. americana, Marsh.* Wild Plum. Red Plum.

Moist open woods and banks of streams; frequent. May or first of June. (B.)

One tree observed, measured 80 feet in height. There are two distinct forms, one with slender branches and large flowers with glandular calyx, found in swamps, and another with stont branches and much smaller flowers, with the calyx less glandular, grows in dry soil.

Prof. Dewey has observed a similar condition in Cayuga Co., N. Y.

264. *P. MARITIMA, Wang.* Beach Plum.

Sandy soil.

One or two specimens were observed at Winnetka in 1882. Rogers Park, frequent. South Evanston, *Johnson!* Lake shore, south, *Marcy, Boltwood, Brennan!* (B. P.)

This is an Atlantic Coast plant, whose presence here can only be explained for the present, at least, by introduction. In its growth, however, it is seemingly indigenous. It is found in the sandy soil of the lake shore.

265. *P. pumila, L.* Dwarf or Sand Cherry.

Sandy soil and bluffs; infrequent. May.

Mainly along the lake shore, both north and south.

Often 6 feet high, *Bastin.*

266. *P. pennsylvanica, L.f.* Wild Red Cherry. Bird Cherry.

Woods; rare. May. (B.)

Chiefly in the northern part of our district. Lake shore, near Chicago, *H. A. Warne, in Plants of Illinois.*

267. *P. virginiana, L.* Choke Cherry.

Woods and banks of streams; frequent. May 5th—June 10th.

268. *P. serotina, Ehrh.* Wild Black Cherry.

Woods; infrequent. May 15th—June 20th. (B.)

SPIRÆA, L.

269. *S. salicifolia*, L. Common Meadow-sweet. Spiræa. Willow-leaved Spiræa. Queen-of-the-Meadow.

Damp prairies; common. June 25th—August.

270. *S. tomentosa*, L. Hardhack. Steeple-bush

Damp prairies; infrequent. July.

Colehour, Ind., and southward.

The flowers are occasionally white.

PHYSOCARPUS, Maxim.

271. *P. opulifolius*, Maxim. Nine-Bark.

Spiræa opulifolia, L.

Banks of streams and swamps; frequent. June—July.

Desplaines River. Stony Island. Hog Island. Riverdale. Calumet Region. Pine Station, Ind. Graceland, Babcock.

RUBUS, Tourn.

272. *R. triflorus*, Rich. Dwarf Raspberry.

Dry woods and sandy knolls; infrequent. June.

Evanston. Calumet Region. Grand Crossing. Miller's and Pine Station, Ind.

The number of sepals and petals varies. A form with six sepals and petals is very often found.

273. *R. strigosus*, Michx. Wild Red Raspberry.

Dry open woods and shrubby fields; infrequent, especially northward. June—July.

A most acceptable fruit.

274. *R. occidentalis*, L. Black Cap. Black Raspberry. Thimbleberry.

Fence rows, fields and open woods; frequent. June—July 10th, sometimes as late as September.

275. *R. villosus*, Ait. Common or High Blackberry.

Open woods, copses and fence-rows; frequent. May—July.

276. *R. villosus*, Ait., var. *frondosus*, Torr.

With the type, and in fields where the timber has been recently removed; not common. (B. P.)

277. *R. villosus*, Ait., var. *humifusus*, T. & G.

Copses and borders of woods; infrequent or rare.

Hyde Park and southward. (B. P.)

278. *R. canadensis*, L. Low Blackberry. Dewberry.

Edges of woods, fields and copses; frequent. June—July.

Frequently follows the removal of timber.

279. *R. hispidus*, L. Running Swamp Blackberry
Damp woods and shaded fields; infrequent. June. (B.)
South Chicago. Calumet Region. Riverside. Miller's, Colehour,
Pine Station and Hammond, Ind. Tolleston, Ind., *Hill*.

GEUM, L.

280. *G. album*, Gmelin. White Aven. Geum.
Open woods and roadsides; common. June—July 25th.
281. *G. virginianum*, L. Virginian Aven.
In rather wet and shaded places; infrequent or rare. June 25th—
September. (B.)
Chiefly southward.
282. *G. strictum*, Ait. Strict Aven.
Moist fields; infrequent. July 20th—August. (B.)
Chiefly south.
283. *G. rivale*, L. Water Aven. Purple Aven.
Wet bogs and swamps; rare. May. (B.)
Southward.

FRAGARIA, Tourn.

284. *F. virginiana*, Mill. Wild Strawberry.
Open woods and fields; common or abundant. May—September.
Often produces fruit a second time during a season.
285. *F. virginiana*, Mill., var. *illinoensis*, Gray.
Woods; not common. June. (B.)
With the type.
286. *F. vesca*, L. Wild Strawberry. Wood Strawberry.
Dry open woods and fields; infrequent. June.

POTENTILLA, L.

287. *P. arguta*, Ph. Cinque-foil. Potentilla.
Dry banks and fields; frequent. June—July 15th.
288. *P. norvegica*, L. Cinque-foil.
Fields and roadsides; frequent or common. June 25th—July, often
as late as September.
289. *P. argentea*, L. Silvery Cinque-foil or Five-finger.
Dry fields, prairies and roadsides; infrequent. June—August.
(B. P.)
Throughout our district.

290. *P. palustris*, Scop. Marsh Five-finger.

Swamps; local. June—July 20th.

South Chicago. Lake Calumet. Grand Crossing. Miller's and Edgemoor, Ind. Rogers Park, *Boltwood*. Normal Park, *Williams*. Pine Station, Ind., *Bastin*.291. *P. fruticosa*, L. Shrubby Cinque-foil.

Wet fields and edges of swamps; not common, usually local. June 20th—July.

Eastern part of our district. Rogers Park. Rose Hill. Niles. South Chicago. Calumet Region. Grand Crossing. Pine Station, Miller's and Clarke, Ind.

292. *P. anserina*, L. Silver Weed.

Damp sandy soil and low sandy marshes; frequent. June—August, occasionally as late as October.

Mainly in the eastern portion of our district.

293. *P. canadensis*, L. Common Cinque-foil. Five-finger.Including var. *Simplex*, T. & G.

Everywhere in dry soil. May—August.

AGRIMONIA, Tourn.294. *A. eupatoria*, L. Common Agrimony.

Open woods and fence-rows; common. July—September.

295. *A. parviflora*, Ait. Small-flowered Agrimony.

Open woods; rare. July. (B.)

Rogers Park. Riverside, *Miss Fannie Seward*.• **ROSA**, Tourn.296. *R. setigera*, Michx. Climbing or Prairie Rose.

July.

But two specimens have been found. One at Morgan Park; the other at Desplaines. Both plants were dwarfed and stunted. (B.) It is cultivated in a number of places.

A specimen in the herbarium of the University of Chicago is labeled, "growing wild at Woodlawn." An ornamental, climbing shrub.

297. *R. engelmanni*, Watson. Engelmann's Rose.Frequent on the borders of sloughs in the southeastern part of our district, near the lake shore; fruit rather oblong, *Hill!* (B. P.)298. *R. blanda*, Ait. Early Wild Rose. Pale Rose.

Sandy soil; frequent. June—July 15th.

Varies greatly in size, 1 to 4 feet. Generally blossoms about three weeks earlier than *R. humilis*.

299. *R. carolina*, L. Swamp Rose.

Low places; rare. June—August.

From Colehour, Ind., southeast; frequent. June.

300. *R. humilis*, Marsh. Dwarf Wild Rose.

R. lucida, in Manual, 5th Ed.

Dry soil, occasionally in open woods and in moist soil at the border of swamps; common south, frequent elsewhere. June—July.

301. *R. ruginosa*, L. Sweet Brier.

Established in old gardens. (B. P.)

PIRUS (*Pyrus*), L.

302. *P. coronaria*, L. American Crab-apple.

Open woods and fields; common locally. June—July 5th.

It is not generally distributed, but is usually found in groups of several trees. The flowers are smaller when in the shade of other trees. A beautiful tree when in blossom.

303. *P. arbutifolia*, L.f. Choke Berry.

Low and damp thickets, south; frequent. May—June.

It is less common in the northern part of the county.

304. *P. americana*, D C. American Mountain Ash.

The only specimen known to be wild in our district was found in the open woods not far north of Windsor Park. This tree was removed in 1888 and transplanted to private grounds on the West side, Chicago. (B. P.)

CRATÆGUS, L.

305. *C. coccinea*, L. Scarlet-fruited Thorn.

Dry banks and woods; frequent. May—June.

306. *C. tomentosa*, L. Black or Pear Thorn.

Woods and banks of streams; infrequent. May 25th—June.

A very variable species, occasionally thornless.

307. *C. punctata*, Jacq. Hawthorn.

C. tomentosa, L., var. *punctata*, Gray.

Glencoe. Miller's, Ind., in woods; rare. (B.)

308. *C. crus-galli*, L. Cockspur Thorn.

Thickets; frequent. June. (B.)

Whiting, Ind., and south. Niles. West of Blue Island. Riverside. Palatine.

AMELANCHIER, Medic.

809. *A. canadensis*, T. & G. Shad-bush. Service-berry.

Including var. *botryapium*, T. & G.

Moist woods and fields; frequent. March 20th—May 10th, occasionally as late as September.

Pétals often much longer than the calyx (4 to 6 times).

810. *A. canadensis*, T. & G., var. *rotundifolia*, T. & G.

With the type; infrequent. (B.)

811. *A. canadensis*, T. & G., var. *oblongifolia*, T. & G.

With the preceding, but less common. April 15th—May. (B.)

SAXIFRAGACEÆ.**SAXIFRAGA, L.**

812. *S. pennsylvanica*, L. Swamp Saxifrage.

Swamps and wet banks; frequent. May—July.

MITELLA, Tourn. Bishop's-Cap.

813. *M. diphylla*, L. Two-leaved Miter-wort.

Rich woods and shaded knolls; common or abundant north, frequent elsewhere. May—June.

Racemes often 6 to 12 inches in length. Flowers occasionally pinkish.

814. *M. nuda*, L. Naked Miter-wort.

A few specimens were observed in the moist rich woods east of Berry Lake, Ind., in 1884, and at Miller's, Ind., in 1886. (B. P.)

HEUCHERA, L.

815. *H. americana*, L. Common Alum-root.

Damp woods and shaded banks; rare. June. (B.)

Glencoe. Riverside, 1878, *Bastin*. Englewood, *Brennan*.

816. *H. hispida*, Ph. Alum-root.

Woods, and in moist soil; frequent. May—July.

Eastern part of our district. Hyde Park and south.

PARNASSIA, Tourn.

817. *P. caroliniana*, Michx. Grass of Parnassus.

Moist fields and banks; common, often abundant south. July—September.

The colored veins on the petals are occasionally pink. Flowers sometimes nearly 2 inches in diameter.

RIBES, L.**818. *R. cynosbati*, L. Prickly Wild Gooseberry.**

Open woods and shaded banks; infrequent. April 25th—May 20th.
(B.)

Chiefly north and west.

819. *R. rotundifolium*, Michx. Wild Gooseberry.

Riverside and along the Desplaines river, infrequent; rare elsewhere.
Riverdale. Cassella, Ind.

820. *R. oxyacanthoides*, L. Smooth Wild Gooseberry.

R. hirtellum, Michx.

Wet open woods and swampy places; frequent. May—June.

821. *R. floridum*, L'Her. Wild Black Currant.

Rich woods; common. May—June.

822. *R. aureum*, Ph. Buffalo or Missouri Currant.

Escaped from cultivation in many places. May—June. (B. P.)

CRASSULACEÆ.**PENTHORUM, Gronov.****823. *P. sedoides*, L. Ditch Stone Crop.**

Wet prairies, fields and ditches; common. July 20th—September.

SEDUM, Tourn.**824. *S. acre*, L. Mossy Stone Crop.**

Escaped from cultivation at Evanston and Rogers Park, June, 1886.
(B. P.)

825. *S. telephium*, L. Garden Orpine. Live-for-ever.

Apparently naturalized in old gardens; occasionally along roadsides. (B. P.)

DROSERACEÆ.**DROSER, L.****826. *D. rotundifolia*, L. Round-leaved Sundew.**

Damp prairies and peat bogs; not common. June—August.

South Evanston, near Asbury Avenue. Near South Chicago.

At South Evanston it is associated with *Lycopodium inundatum*, L.

From Cassella, Ind., south to limits, it is frequent.

Petals sometimes tinged with pink, which is rarely in narrow, faint lines. Styles usually five.

827. *D. intermedia*, Hayne, var. *americana*, D C. Long-leaved Sundew.

D. longifolia, in Manual, 5th Ed.

Swamps; rare. July—August.

South Chicago. Miller's, Ind., *Bastin*.

HAMAMELIDÆ.**HAMAMELIS, L.**

828. *H. virginiana*, L. Witch-hazel.

Rich open woods and copses; infrequent. September—November.
More common in the southern portion of our district; September.
Less frequent, north and west.

HALORAGÆ.**MYRIOPHYLLUM, Vaill. Water Milfoil.**

829. *M. spicatum*, L.

Aquatic; frequent. July—August. (B.)
More frequent south.

880. *M. verticillatum*, L.

In more stagnant water; frequent. July—August. (B.)

881. *M. heterophyllum*, Michx.

Slow streams, lakes and ponds; infrequent. June—July. (B.)

PROSERPINACA, L.

882. *P. palustris*, L. Mermaid-weed.

Swamps and ditches, chiefly in the southern part of our district;
frequent. July.

HIPPURUS, L.

888. *H. vulgaris*, L. Mare's Tail.

Near the northern end of Lake Calumet. Chicago river, west of
Brighton; rare, July, 1886. Miller's and Pine Station, Ind., 1888.
Clarke, Ind., 1886. (B.)

CALLITRICHE, L.

884. *C. verna*, L. Water Starwort.

Several specimens were found near the Calumet river, within a few
rods of the C. P. & Ft. Wayne R.R. The form was the terrestrial,
(*C. brevifolia*, Ph.).

Possibly a waif, introduced from the east, but may be found in other
localities. It blooms from spring to fall. (B.)

MELASTOMACEÆ.**RHEXIA, L.**

885. *R. virginica*, L. Deer-Grass.

Pine Station, Ind. Miller's Ind., *Babcock!* Tolleston and Ham-
mond, Ind., *Hill*.

LYTHRACEÆ.

DIDIPLIS, Raf.

886. *D. linearis*, Raf. *Didiplis*.

Ammannia nuttallii, Gray.

In rather deep water; rare, July, 1887. Lake Calumet. (B.)

The flowers are exceedingly minute, and easily passed unnoticed.

LYTHRUM, L.

887. *L. alatum*, Ph. Loosestrife.

Wet prairies; common. June—July.

Occasionally the white-flowered form is met with.

DECODON, Gmelin.

888. *D. verticillatus*, Ell. Swamp Loosestrife.

Nesaea verticillata, H. B. K.

Swamps; rare. July, 1887.

Near Miller's, Ind. (B.)

ONAGRACEÆ.

LUDWIGIA, L.

889 *L. alternifolia*, L. Seed-box.

Swampy places; infrequent or rare. July—August.

Near Evanston. South Chicago and south.

840. *L. polycarpa*, Short & Peter. False Loosestrife.

Swamps, especially southward. August—September.

Ditches at Glencoe and Riverside; not common, *Babcock*. Evanston, *Boltwood*.

841. *L. palustris*, Ell. Water Purslane.

Ditches, banks of streams and low muddy brooks; infrequent.

July—September.

Evanston and vicinity. Riverside. Rice Township. Graceland,

Babcock. Near Pullman, *Brennan*.

EPILOBIUM, L.

842. *E. angustifolium*, L. Great Willow-herb. Fireweed. Rose-Bay.

Usually in copses and low grounds; occasionally found on higher ground when the flowers are often decidedly purple; frequent.

July—August. (B.)

Flowers occasionally white.

848. *E. lineare*, Muhl. Linear-leaved Willow-herb.

E. palustre, L., var. *lineare*, Gray.

Swampy places, in sandy soil; infrequent or rare. August.

Near the lake shore, both north and south.

There are two forms in our district:

- (a) Pubescent; petals nearly white or tinged with purple (the type).
- (b) Nearly glabrous; stem simple; 1 to 4 flowered; pods quite smooth; leaves lanceolate; rare, Pine Station, Ind., August, 1879, *University of Chicago Herb.* Possibly this form is *E. palustre*, L.

844. *E. strictum*, Muhl. Downy Willow-herb.

E. molle, Torr.

Occasionally found near the north end of Lake Calumet, 1885, 1887, and the "low lands adjacent to the river southwest of Crawford," *C. P. Murray*. (B.)

845. *E. coloratum*, Muhl. Willow-herb.

Low places, wet prairies and ravines; not common. July—August.

GENOTHERA, L.

846. *G. biennis*, L. Common Evening Primrose.

Fields, prairies and waste places; common or abundant locally. June 25th—August.

847. *G. biennis*, L., var. *grandiflora*, Lin

In rich soil; frequent. July. (B.)

848. *G. biennis*, L., var. *cruciata*, T. & G.

Prairies south of Garfield Park; rare (1888). July. *Riverside, Babcock. Eggleston, Hill.*

849. *G. rhombipetala*, Nutt. Evening Primrose.

Sandy soil, near lake shore, both north and south; rare. July 20th—September.

Bluffs near Berry Lake, Pine Station and Miller's, Ind. *Evanston, Johnson.*

850. *G. fruticosa*, L. Sundrops.

Shrubby fields, etc.; frequent. June—August.

851. *G. pumila*, L. Primrose.

Gibson's, Ind.; rare, *Babcock. Palatine and Desplaines; rare. June.*

GAURA, L. *Gaura*.

852. *G. biennis*, L.

Infrequent; rare, north and west. August.

Banks of Desplaines and Calumet rivers. *Englewood, Brennan.*

853. *G. parviflora*, Dougl.

A single plant near the railroad bridge at Maywood, *Babcock. A*
single plant at Pullman on the banks of Lake Calumet.

Probably introduced from the west or south. (P.)

CIRCÆA, Tourn.

854. *C. lutetiana*, L. Tall Enchanter's Nightshade.

Rich and rather open woods, or in underbrush after the removal of timber; common. July—August.

855. *C. alpina*, L. Low Enchanter's Nightshade.

Deep woods, usually in damp places; rather rare. July. (B. P.)

Niles. Berry Lake, Ind. Evanston, *Boltwood*. Arlington Heights,
C. P. Murry.

CURCUBITACEÆ.**SICYOS, L.**

856. *S. angulatus*, L. One-seeded Star Cucumber.

Banks of streams and damp waste places; infrequent. July—August. (B.)

ECHINO CYSTIS, T. & G.

857. *E. lobata*, T. & G. Wild Cucumber. Wild Balsam-apple.

Banks of streams and rich moist soil; common. July—September.

CACTACEÆ.**OPUNTIA, Tourn.**

858. *O. rafinesquii*, Engelm. Prickly Pear Cactus.

Sandy soil. June—July.

Common near the lake shore both north and south.

This species is very ornamental when in blossom, and is easily cultivated.

FICOIDEÆ.**MOLLUGO, L.**

859. *M. verticillata*, L. Carpet-weed. Indian Chick-weed.

Sandy soil; not common. June—August.

Lake shore, chiefly south.

UMBELLIFERÆ.**DAUCUS, Tourn.**

860. *D. carota*, L. Carrot.

Occasionally spontaneous in waste places and old gardens, but usually dies out in three or four years. July—September. (B.)

ANGELICA, L.

861. *A. atropurpurea*, L. Great Angelica.

Archangelica atropurpurea, Hoffm.

Bogs and banks of streams south and southeast; not common. June. Occasionally found on the banks of the Desplaines river. (B.)

TIEDEMANNIA, D C.862. *T. rigida*, Coult. & Rose. Cowbane.*Archemora rigida*, D C.

Sandy swamps southward; infrequent. July.

HERACLEUM, L.863. *H. lanatum*, Michx. Cow Parsnip.

Moist places; frequent, rather local. June.

Specimens have been found that measured 9 feet in height. A specimen was obtained near Lake Calumet with the umbel $1\frac{1}{2}$ feet broad.**PASTINACA, L.**864. *P. sativa*, L. Common Parsnip.

Escaped from cultivation in various places. (B.)

POLYTÆNIA, D C.865. *P. nuttallii*, D C.

Prairies and old fields; infrequent or rare. May—June 15th.

Evanston. Ravenswood. Whiting, Ind. Maywood, rare, *Babcock*!**THASPIUM, Nutt.**866. *T. aureum*, Nutt. Meadow Parsnip.

Banks of streams and moist places; common. May—June.

867. *T. aureum*, Nutt., var. *trifoliatum*, Coult. & Rose.*T. trifoliatum*, in Manual, 5th Ed., in part.

Rich woods; common. June 15th—July.

868. *T. aureum*, Nutt., var. *atropurpureum*, Coult & Rose.*T. trifoliatum*, Nutt., var. *atropurpureum*, Gray.

With the type; rare. June. (B.)

869. *T. barbinode*, Nutt. Meadow Parsnip.

Banks of streams; infrequent. July. (B.)

PIMPINELLA, L.870. *P. integerrima*, Benth. & Hook. Golden Alexanders.*Zizia integerrima*, D C.

Dry banks. May 10th—June.

Frequent north and west; less frequent south.

EULOPHUS, Nutt.871. *E. americanus*, Nutt.Woods at Riverside, *Babcock*.**CRYPTOTÆNIA, D C.**872. *C. canadensis*, D C. Honewort.

Moist grounds; infrequent. June—September.

Probably not found in the northwestern portion of our district.

SIUM, Tourn.

- 878.
- S. cicutæfolium*
- , Gmelin. Water Parsnip.

S. lineare, Michx.

In swampy places, occasionally in water; frequent, especially south.
July—August 25th.

Riverside, west of Desplaines river; rare, *Babcock!*

BERULA, Koch.

- 874.
- B. angustifolia*
- , Koch. Water Parsnip.

Sium angustifolium, L.

Swamps; not common. August. (B.)

OARUM, L.

- 875.
- O. carui*
- , L. Common Caraway.

Sparingly escaped from cultivated grounds to roadsides. June—
July. (B. P.)

A pink flowered form was observed near Halsted and 55th Streets.

CICUTA, L.

- 876.
- C. maculata*
- , L. Spotted Cowbane. Musquash-root. Beaver Poison.

Swamps and low banks of streams; infrequent. July—August. (B.)

- 877.
- C. bulbifera*
- , L. Bulb-bearing Water-hemlock.

Swampy places; not common. August—September.

South Chicago and south. Whiting, Colehour and Casella, Ind.
Edgemoor, Ind., *Johnson*. Pine Station, Ind., *Babcock*.

CONIUM, L.

- 878.
- C. maculatum*
- , L. Poison Hemlock.

Waste places; infrequent or rare. July—September. (B.)

Evanston, Palatine and Riverside.

CHÆROPHYLLUM, L.

- 879.
- C. procumbens*
- , Crantz. Chervil.

Moist open woods and copses; not rare. May—June.

Wood at Riverside; common, *Babcock!*

OSMORRHIZA, Raf.

- 880.
- O. brevistylis*
- , D C. Hairy Sweet Cicely.

Rich woods; frequent. May 15th—June 10th. (B.)

- 881.
- O. longistylis*
- , D C. Smooth Sweet Cicely.

Rich moist woods; frequent, especially south. May—June.

Evanston. Bowmansville. Niles. Desplaines. Riverside. River-
park, *Bastin!* Blue Island, *Dodge*.

ERIGENIA, Nutt.

882. *E. bulbosa*, Nutt. Harbinger-of-Spring. Pepper-and-Salt.
Maywood and Riverside, on the banks of the Desplaines river, 1887.
Lamont, rare, March, 1889. Chesterton, Ind., *Hill*. (B.)

HYDROCOTYLE, Tourn.

888. *H. americana*, L. Water Pennywort.
Damp woods and shaded banks; infrequent or rare. July—August.
(B. P.)

ERYNGIUM, Tourn.

884. *E. yuccæfolium*, Michx. Rattlesnake Master. Button Snake-root.
Damp prairies, and the pine barrens of the southern portion of our district; infrequent, except from Hyde Park south. Leaves often very long. The aspect of the plant is often endogenous.

SANICULA, Tourn.

885. *S. marilandica*, L. Sanicle. Black Snake-root.
Woods; infrequent. June—July.
Glencoe. Niles. South of Chicago. Near North Branch of Chicago river, *Babcock*!
886. *S. marilandica*, L., var. *canadensis*, Torr. Sanicle. Black Snake-root.
S. canadensis, L.
Open woods and copses; common. June—August.
Leaves very thin, often 4 to 5 inches long.

ARALIACEÆ.**ARALIA**, Tourn.

837. *A. racemosa*, L. Spikenard.
Moist, rich woods; infrequent or rare. July—August.
Ravines of the northeast. Riverside. Hog Island. Berry Lake and Pine Station, Ind.
888. *A. nudicaulis*, L. Wild or False Sarsaparilla.
Moist woods; frequent. May—June.
Ravines of the northeast and from Hyde Park southward.
889. *A. quinquefolia*, Decsne. & Planch. Ginseng.
Panax quinquefolia, L.
Rich woods; infrequent or rare. July. (B.)
Highland Park, Lake Co., Ill. Riverside. Calumet Region. Palatine. Forest Hill; rare, *Hill*.

890. *A. trifolia*, Decsne. & Planch. Dwarf Ginseng. Ground-nut.

. *Panax trifolia*, L.

Moist rich woods; rare. April 20th—May 15th.
Southward. Casella and Miller's, Ind. (B.)

CORNACEÆ.

CORNUS, Tourn.

891. *C. canadensis*, L. Dwarf Cornel. Bunch-berry.

Woods. May 20th—June.

From South Chicago southeast; rare. Rogers Park, *Boltwood*!
Pine Station, Ind.; rare, *Babeock*!

A specimen collected near Wolf Lake, Ind., has an incomplete, compound umbel.

892. *C. florida*, L. Flowering Dog-wood.

Woods; infrequent in the more elevated portions of the northern part of the county; rare elsewhere. May—June. (B.)

Miller's and Berry Lake, Ind. Chesterton, Ind., *Hill*

A beautiful tree with showy blossoms and fruit.

898. *C. circinata*, L'Her. Round-leaved Dog-wood.

Open, rich woods and copses; infrequent. June—August 10th. (B.)

Southeast. Pine Station, Ind., *Bastin*! Miller's, Ind., *Hill*!

The leaves of this species are occasionally 7 inches broad. A shrub growing near Miller's, Ind., had rather dark blue fruit.

894. *C. sericea*, L. Silky Cornel. Kinnikinnik.

Banks of streams and swamps; more common south, less frequent elsewhere. June 10th—July. (B.)

Lake shore, both north and south.

The inner bark is mixed with tobacco by the Indians forming "Kinnikinnik."

895. *C. stolonifera*, Michx. Red-osier Dog-wood.

Banks of streams and wet places; infrequent. May—July 10th.

Mainly south of Hyde Park.

A second set of blossoms is often produced in August or September.

It occasionally forms large matted clumps several feet in diameter, due to growths of underground and prostrate branches, which root and soon develop into large shrubs.

896. *C. paniculata*, L'Her. Panicked Cornel.

Banks of streams and wet woods; common. May 20th—June.

897. *C. alternifolia*, L.f. Alternate-leaved Cornel.

Woods and copses; frequent. May 15th—June.

More common in the northern part of our district. Glencoe. Riverdale. Maywood. Riverside. Blue Island. Palatine. Lyons. Miller's, Ind.

Flowers are rarely pink.

NYSSA, L.898. *N. sylvatica*, Marsh. Pepperidge. Black or Sour Gum.

N. multiflora, Wang.

Wet and rich soil. May—July.

Niles woods; rare. Cassella and Pine Station, Ind.; infrequent.

Miller's, Ind.: common, *Babcock*!

CAPRIFOLIACEÆ.**SAMBUCUS, Tourn.**899. *S. canadensis*, L. Common Elder.

Banks of streams and rich open woods; infrequent. June.

VIBURNUM, L.400. *V. opulus*, L. Cranberry-tree. Bush Cranberry.

Low places and rich woods, both north and south; not common. June.

Glencoe. Evanston. Berry Lake, Ind. Graceland, *Babcock*! Whiting, Ind., *Hill*!

The cultivated form is the well-known Snowball-tree, or Guelder Rose. It has sparingly escaped from cultivation in various places, and is occasionally found with only a portion of the cyme, consisting of sterile flowers.

401. *V. acerifolium*, L. Maple-leaved Arrow-wood. Dockmackie.

Woods, both north and south; infrequent, especially northward. May 15th—June.

402. *V. pubescens*, Ph. Downy Arrow-wood.

Wooded banks, bluffs and thickets; frequent in the northern part of the county, less common elsewhere. May—June.

Seldom over four feet in height.

403. *V. dentatum*, L. Arrow-wood.

Damp woods and wet places; infrequent. June.

Near the lake shore. Riverside, *Babcock*.

404. *V. lentago*, L. Sweet Viburnum. Sheep-berry. Black Haw.

Open woods, copses and banks of streams; infrequent. May—June.

Winnetka. Riverside. South Chicago. Palatine. Glencoe, *Babcock*. Rose Hill, *Johnson*. Englewood, *Brennan*. Grand Crossing, *Hill*.

The average height of the species is about 18 feet. It is occasionally shrub-like, attaining a height of not over 10 feet.

405. *V. prunifolium*, L. Black Haw.

Chicago, *Bastin*. Near Oak Park, *S. R. Copeland*. Morgan Park, *University of Chicago Herb.* (B.)

TRIOSTEUM, L.

406. *T. perfoliatum*, L. Fever-wort. Horse-gentian.

Rich, moist woods; generally distributed, but not common. June. Niles. Lyons. Palatine. Riverside. Calumet Region. Miller's and Whiting, Ind. Lakeside, *Johnson*.

407. *T. angustifolium*, L. Horse-gentian.

Moist woods; very rare. (B.)

Maywood, 1884. Near Lake Calumet, 1886. Lake Calumet, 1874. *University of Chicago Herbarium*.

No specimens have been found at either place since 1886. The species is seemingly exterminated.

LINNÆA, Gronov.

408. *L. borealis*, Gronov. Twin-flower. Linnæa.

Pine and cedar woods of the southern portion of our district; very rare. May 25th—July, 15th. (B.)

Miller's, 1886, and Berry Lake, 1888, Ind. Pine Station, Ind., *Bastin*, *Hill*, *Brennan*. Edgemoor, Ind., in bloom, September 15th, *Hill*. Winnetka, *Vasey*,—in *Northwestern University Collection*.

LONICERA, L.

409. *L. ciliata*, Muhl. Fly Honeysuckle.

Rich woods and ravines in the northeastern portion of Cook County; rare. May—June. (B. P.)

Evanston. Niles. Rogers Park. Desplaines. Pine Station, Ind., *Bastin*.

410. *L. sempervirens*, Ait. Trumpet Honeysuckle.

Apparently escaped from cultivation at Evanston. (B. P.)

411. *L. sullivantii*, Gray.

L. flava, in Manual, 5th Ed., mainly.

Woods; infrequent or rare. June.

Evanston. Near Riverside. Riverdale. Lamont. Englewood, *Dodge*.

412. *L. glauca*, Hill. Yellow or Small Honeysuckle.*L. parviflora*, Lam.*L. parviflora*, Lam., var. *douglasii*, Gray.

Rich woods; frequent north. May 15th—June.

Riverside. Clarke, Miller's, Casella and Pine Station, Ind., infrequent or rare. Banks of Lake Calumet, Hill. South Chicago, Brennan.

Flowers rarely pure yellow.

DIERVILLA, Tourn.418. *D. trifida*, Moench. Bush Honeysuckle.

Open woods; rare. June—July.

Evanston. Riverside. Hog Island, 1886. Hyde Park, Babcock.

RUBIAOEÆ.**HOUSTONIA**, L.414. *H. cœrulea*, L. Bluets. Wild Forget-me-not. Innocence.

Moist places. May—August.

Wilmette to Hyde Park; rare. Englewood, Dodge. Calumet Region, south and east, in moist, sandy soil; common.

415. *H. purpurea*, L., var. *ciliolata*, Gray.

Sandy soil, southeast; rare. June. (B.)

Hessville, Ind., Hill.

CEPHALANTHUS, L.416. *C. occidentalis*, L. Button-Bush.

Banks of streams and lakes, wet open woods and swamps; frequent. July—August.

Occasionally attains a height of 8 to 10 feet.

MITCHELLA, L.417. *M. repens*, L. Partridge-berry. Squaw-plum.

Woods. July. (B.)

Northward, infrequent; from Colehour, Ind., southeast, frequent.

The form, with both the flowers confluent, has been found at Miller's, Ind.

GALIUM, L. Bed-straw.418. *G. aparine*, L. Cleavers. Goose-grass.

Wet woods and prairies; frequent or common. May—June 15th.

Stems often from 2 to 5 feet long, and when reclining on other plants, will reach a height of 2 feet or more.

419. *G. pilosum*, Ait.

Copses; frequent. July. (B.)

420. *G. circæzans*, Michx. Wild Liquorice.

Dry woods and copses; common. July. (B.)

421. *G. boreale*, L. Northern Bed-straw.

Sand ridges, bluffs and ravines of the eastern portion of our district; frequent. July.

422. *G. trifidum*, L. Small Bed-straw. Dyer's Cleavers.

Swamps and low grounds; common, especially south, rarely abundant. June 20th—July.

Prof. Hill reports the following interesting forms from Englewood:

- (a.) Leaves lance-linear in whorls of 4 to 6; angles of stem smoothish. Has two forms of flowers by intercrossing.
- (b.) Protandrous and diomorphic, the style being long, rising somewhat to the top of the corolla lobes; the anthers are then withered and black, the stamens barely reaching the clefts of the corolla limb.
- (c.) Has the stamens long and the style short, the stamens arching inwards and rising about half the length of the corolla lobes; the anthers are flesh and yellowish-green; the stigma is almost sessile. Both forms grow together in damp portions of door-yards.

423. *G. trifidum*, L., var. *latifolium*, Torr.

With the last, near Stony Island, July, 1886. (B. P.)

424. *G. trifidum*, L., var. *pusillum*, Gray.

Swampy grounds, Forsythe, Hill. (B. P.)

425. *G. concinnum*, T. & G.

Rather dry, open woods and copses; frequent. July.

426. *G. asprellum*, Michx. Rough Bed-straw. Catch-weed.

Wet woods and swampy fields; infrequent. July—August. (B.)

427. *G. triflorum*, Michx. Sweet-scented Bed-straw.

Moist rich woods and fields; frequent or common. June—July. (B.)
Fruit greenish-white.

VALERIANACEÆ.

VALERIANA, Tourn.

428. *V. edulis*, Nutt. Valerian.

Damp prairies; frequent. May—June.

Chiefly in the eastern portion of our district.

VALERIANELLA, Tourn.

- 429.
- V. CHENOPODIFOLIA**
- , D C. Corn Salad.

Fedia fagopyrum, T. & G.Swamps near Lake Calumet, east of M. C. R. R. June 1885-86.
(B. P.)

Evidently introduced from the east. So far as we know, no other specimens have been found.

- 480.
- V. radiata**
- , Dufr. Corn Salad.

Fedia radiata, Michx.Lake Calumet, June, 1882, *University of Chicago Herbarium*. (B.)**DIPSACEÆ.****DIPSACUS**, Tourn.

- 481.
- D. SYLVESTRIS**
- , Mill. Wild Tassel.

Rare.

Near Austin, on O. & N. W. R. R.; evidently introduced. Hyde Park and Washington Heights, *University of Chicago Herb*. (B.)**COMPOSITÆ.****VERNONIA**, Schreb. Iron-weed.

- 482.
- V. fasciculata**
- , Michx.

Prairies, open woods and banks; common. August—September.

Very variable. In two or three localities near Grand Crossing, its similarity to the next species is easily shown. Plants growing near each other and under the same conditions, show a quite perfect gradation between the two types. Several specimens attained a height of 9 feet.

- 488.
- V. noveboracensis**
- , Willd.

Banks of streams; infrequent. August. (B.)

The later flowers are usually lighter colored than the earlier ones.

EUPATORIUM, Tourn.

- 484.
- E. purpureum**
- , L. Joe-pye-weed. Trumpet-weed. Purple

Boneset. Queen-of-the-Meadow. Gravel-root.

Low places; infrequent. July 25th—September.

Very variable in size.

- 485.
- E. sessilifolium**
- , L. Upland Boneset.

Banks of ravines; probably rare, except in the northern part of our district, where it is infrequent. August. (B.)

- 486.
- E. perfoliatum**
- , L. Boneset. Thoroughwort.

Prairies and low places; common, abundant locally. August—September.

487. E. ageratoides, L. White Snake-root.

Open woods, old yards and damp places; frequent. August—September.

Abundant in Niles woods.

KUHNIA, L.**488. K. eupatorioides, L.**

Dry soil, roadsides, etc.; frequent. August 15th—September. (B.)

LIATRIS, Schreb. Button Snake-root. Blazing Star.**489. L. squarrosa, Willd.**

Dry banks, near the lake shore; not common. August. (B.)

440. L. cylindracea, Michx.

Prairies, dry fields, etc.; frequent. July 25th—September.

Common at Ravenswood, Hyde Park and southward.

441. L. scarlosa, Willd.

Dry fields, prairies, etc.; common south in sandy soil. August—September.

A specimen was collected during the season of 1887, near Waldheim Cemetery, with white flowers.

The heads of a plant found near Evanston were nearly two inches in diameter. A variable species.

442. L. pycnostachya, Michx.

Prairies; Ravenswood, frequent, not so common elsewhere. (B.)

448. L. spicata, Willd.

Moist places; common. August—September.

Specimens bearing white flowers were found at Ravenswood and Summerdale.

GRINDELIA, Willd.**444. G. SQUARROSA, Dunal. Grindelia. Gum Plant.**

Undoubted specimens have been collected in an unimproved field near South Evanston. The specimens were very resinous.

After a thorough investigation, it is evident that the presence of this species—which is a native of the plains west of the Mississippi—within the limits of our Flora, cannot be accounted for in any other way than by introduction, although seemingly indigenous. *Marcy, Boltwood, Johnson, Dunham!* (B. P.)

SOLIDAGO, L. Golden-rod.**445. S. cæsia, L.**

Rich moist woods and copses; infrequent. September. (B.)

446. *S. latifolia*, L.

Shaded banks and ravines; infrequent. September.

447. *S. bicolor*, L., var. *concolor*, T. & G.

Banks of the C. P. & Ft. W. R. R., near Whiting, Ind., 1887. (B.)
Probably a waif introduced from the east.

448. *S. humilis*, Ph.

S. virgaurea, L., var. *humilis*, Gray.

In sandy soil near the lake shore, chiefly southward; infrequent or rare.

449. *S. uliginosa*, Nutt.

S. stricta, Ait.,* in Manual, 5th Ed.

Swamps and low grounds; infrequent or rare. July—August.

Swamps south of South Chicago. Riverdale. Casella and Pine Station, Ind. Swamps near Graceland, Babcock. Miller's, Ind., Bastin.

Some forms closely resemble *S. neglecta*.

450. *S. speciosa*, Nutt.

Woods and shaded banks, rarely in open fields; frequent. August 25th—October.

Easily cultivated, becoming very ornamental.

451. *S. speciosa*, Nutt., var. *angustata*, T. & G.

A dwarf form in dryer places than the type; infrequent. Sept. (P.)

452. *S. patula*, Muhl.

Wet banks and swamps; probably frequent. Aug.—Sept. (B.)

South Holland and Berry Lake, Ind. Near Pullman. South Chicago. Banks of the Desplaines river, near Maywood.

453. *S. rugosa*, Mill.

S. altissima, T. & G.

Roadsides, dry fields and banks; common. August 10th—September 25th. (B.)

Very variable; locality and soil causing peculiarities of growth.

454. *S. ulmifolia*, Muhl.

Damp open woods and low grounds; frequent. September.

455. *S. neglecta*, T. & G.

Swamps of the Calumet Region. Near the junction of the Grand and Little Calumet rivers. Specimens were found in the above localities during the seasons of 1884-'85-'87.

Near Chicago, Babcock,—in *Plants of Illinois*. (B.)

**S. stricta*, Ait., is the *S. virgata*, Michx., and is an eastern form.

456. *S. arguta*, Ait.*S. muhlenbergii*, T. & G.

Pine Station, Ind.; rare, Babcock.

457. *S. juncea*, Ait.*S. arguta*, T. & G.

Banks of streams, open woods and moist fields; frequent. August—September. (B. P.)

458. *S. missouriensis*, Nutt.

Rather dry fields and prairies; infrequent. August. (B.)

Near Garfield Park. Riverside. Hyde Park, Bastin.

459. *S. serotina*, Ait.*S. gigantea*, in Manual, 5th Ed.

Woods, fence-rows and dry banks; common. August—October.

460. *S. serotina*, Ait., var. *gigantea*, Gray.*S. serotina*, in Manual, 5th Ed.*S. gigantea*, Ait.

Woods and damp grounds; frequent. August—September. (B.)

461. *S. canadensis*, L.

Borders of woods, roadsides and fence-rows; common, often abundant. August—September, often as late as November.

Variable in size, often growing 8 feet high.

A few specimens were found near Glencoe with smoothish leaves.

462. *S. canadensis*, L., var. *procera*, T. & G.

On higher grounds than the type. September.

Near Palatine; rare. (B. P.)

463. *S. nemoralis*, Ait.

Dry prairies and barren fields; common or abundant. August—September.

464. *S. rigida*, L.

Prairies, open woods and fence-rows; frequent or common. August—September.

Varies from 2 feet on prairies to 3 to 5 feet in woods.

465. *S. ohioensis*, Riddell.

Moist prairies and banks; infrequent. September.

Chiefly in the eastern part of our district.

Summerdale. Graceland. Hyde Park near 55th St. Egondale.

Whiting, Ind., and south. Englewood, Ill. Edgemoor, Ind., Johnson/

466. *S. riddellii*, Frank. Riddell's Golden-rod.
Prairies; common. September.
467. *S. lanceolata*, L.
Low banks of streams and lakes, moist fields, etc.; frequent or common. August 15th—September. (B.)
468. *S. tenuifolia*, Ph.
Sandy soil, chiefly in the eastern portion of our district; frequent or common. August—September.
- BOLTONIA**, L'Her.
469. *B. asteroides*, L'Her.
Includes *B. glastifolia*, L'Her.
Moist places, chiefly southward; infrequent. September.
Lake shore, near 83rd St., Babcock.
The awned form is seemingly the most common, and occasionally specimens are found with simply an indication of awns.
- ASTER**, L. Aster.
470. *A. macrophyllus*, L. Large-leaved Aster.
Moist woods and fields; frequent north. August—September.
471. *A. oblongifolius*, Nutt.
Banks of the Desplaines river, near Maywood; rare. September, 1886. (B.)
472. *A. novæ-angliæ*, L. New England Aster.
Moist prairies, banks and hedge-rows; frequent or common. September.
A single white-flowered specimen was found in 1888 at Wilmette by Miss Belle Alting.
Rays white, Englewood, Hill.
473. *A. novæ-angliæ*, L., var. *roseus*, D C.
With the type; very rare.
Riverside, September, 1888. (B. P.)
474. *A. sericeus*, Vent. Silky Aster.
Dry soil, banks of lakes and streams, open woods, etc.; frequent or common. July 25th—September.
A beautiful plant, and easily cultivated.
In very dry seasons the leaves are sometimes nearly smooth on the upper surfaces.
475. *A. patens*, Ait.
Dry fields and banks; frequent, or common locally. August—September, occasionally as late as October.
Flowers violet to dark blue-purple.

476. *A. patens*, Ait., var. *phlogifolius*, Nees.
Found on the shaded banks of the Desplaines river, near Maywood;
rare. Flowers purple. (B. P.)
477. *A. azureus*, Lindl. Azure Aster.
Prairies, dry banks and copses; frequent, though rare in open woods
north of Ravenswood. August—September.
Stem nearly or quite smooth; rays fading to pink or purplish-pink;
Pine Station, Ind., in woods, *Hill*.
478. *A. undulatus*, L. Wavy Aster.
Dry open woods and copses; frequent. September.
479. *A. cordifolius*, L. Heart-leaved Aster.
Dry open woods and fields; common or abundant in the western
portion of Cook County. September—October.
480. *A. sagittifolius*, Willd. Arrow-leaved Aster.
Dry places; not common. September—October.
Evanston. Wilmette. Hyde Park and southward. Banks of the
Desplaines river.
481. *A. drummondii*, Lindl. Drummond's Aster.
Banks of the Desplaines river at Riverside, *Hill*/ (B.)
482. *A. turbinellus*, Lindl.
Evanston. Woodlawn, near the Driving Park; rare, 1886. (B.)
483. *A. laevis*, L. Smooth Aster.
Common. Type specimens are rare, and found at Graceland, Oak
Park, Hawthorn, and Kensington; Evanston, *Johnson*!
Prairies of the western part of Cook County; rare, *S. P. Copeland*.
Banks of the Desplaines river; common, *Babcock*!
The species is very variable, highly ornamental and easily cultivated.
484. *A. polyphyllus*, Willd.
Swamps and low places; infrequent. September. (B. P.)
485. *A. ericoides*, L. Heath-like Aster.
August 25th—September.
Formerly quite common from 50th St. south, in lake shore woods;
now infrequent. Frequent in dry fields in the southwestern part
of the county; infrequent north and west. (B.)
486. *A. ericoides*, L., var. *villosus*, T. & G.
Ravenswood; rare, 1884-85 Stony Island; rare. Thorn Creek,
Thornton, *Hill*. (B.)

487. *A. multiflorus*, Ait. Many-flowered Aster.

Usually in dry sandy soil; common, abundant in the eastern portion of our district.

Plants with the stems simple or but little branched are not uncommon, especially in barren places.

488. *A. dumosus*, L.

Dry woods and shaded places; frequent. September. (B.)

A variable species, both as to size, color of flowers, and foliage. A much attenuated form is frequently found on barren banks.

489. *A. vimineus*, Lam.

A. tradescanti, in Manual, 5th Ed.

Banks of streams and moist places; common. August 15th—September.

Bush like, often appearing top heavy, becoming prostrate. Ornamental and easy of cultivation.

490. *A. diffusus*, Ait. Diffuse Aster.

A. miser, in Manual, 5th Ed.

Woods and damp places; common or abundant. Aug.—Oct. 15th. Very variable.

A form, probably var. *thyrsoides*, Gray, closely resembles *A. tradescanti*, L.

491. *A. tradescanti*, L. Tradescant's Aster.

A. tenuifolius, in Manual, 5th Ed.

Low open woods, fields and fence-rows; frequent. August 20th—October. (B.)

492. *A. paniculatus*, Lam.

A. simplex, Willd.

Moist places; frequent or common. September—October. (B.)

493. *A. salicifolius*, Ait. Willow-like Aster.

A. carneus, in Manual, 5th Ed.

A. greenei, T. & G.

Swamps or moist places; rare. (B.)

Near Lake Calumet, September, 1888.

Prof. Hill reports "a somewhat puzzling form, but with characters more nearly agreeing with *A. greenei*, T. & G., than any other apparently. The leaves are not scabrous except a little near the top, and the serratures seem rather more prominent; rays white or lightly tinged with purple. Height 3 feet. Prairie, Englewood."

494. *A. novi-belgii*, L.*A. longifolius*, in *Manual*, 5th Ed.

Low ground near the north end of Lake Calumet; rare. September, 1884-85.

Glencoe; common, *Babcock*.495. *A. prenanthoides*, Muhl.Near Chicago, *University of Chicago Herbarium*. (B.)496. *A. puniceus*, L.

Moist woods and swamps; common, especially south. September—October. (B.)

The white-rayed form is quite common near Lake Calumet.

497. *A. puniceus*, L., var. *lucidulus*, Gray.Var. *vimineus*, T. & G.

With the type; rare. September. (B.)

Nearly or quite smooth.

498. *A. umbellatus*, Mill. Double-bristled Aster.*Diplopappus umbellatus*, T. & G.

Moist places; infrequent south. August—September.

499. *A. linariifolius*, L. Double-bristled Aster.*Diplopappus linariifolius*, Hook.

Dry soil; common. September.

A form with pure white rays is occasionally found.

500. *A. ptarmicoides*, T. & G.

Sandy soil. September.

Rogers Park; rare. Hyde Park, south and southeast; frequent.

A form growing at Englewood, possibly Var. *lutescens*, Gray, is reported by Prof. Hill as follows: Some plants with yellowish rays and decidedly yellow disk flowers; others nearly white; heads smaller than normal; leaves nearly or quite clasping, long linear-lanceolate and inclined to be smoother than ordinary; something like *Solidago Riddellii*; heads about $\frac{1}{2}$ -inch in diameter; involucre more cylindrical than in *A. ptarmicoides*, and smaller. A remarkable form appearing as if a hybrid between *A. ptarmicoides* and *Solidago riddellii* or *tenuifolia*, both of which are common in the same locality, and all grow more or less intermingled. If crosses between Asters and Golden-rods be possible, I should take this for one.

ERIGERON, L. Erigeron. Fleabane.**501. E. canadensis, L. Horse-weed. Butter-weed.**

Dry prairies, waste fields, etc.; everywhere common, often abundant.
July—September.

502. E. divaricatus, Michx. Dwarf Fleabane.

Dry sandy soil near the state line, north to South Chicago, and west to M. C. R. R. tracks; rare. June. (B.)

Only five specimens have been reported.

503. E. annuus, Pers. Daisy Fleabane. Sweet Scabins.

Everywhere in rather dry, waste places; common or abundant.
June—September.

A specimen cultivated under the direction of the writers has dark purple rays.

504. E. strigosus, Muhl. Daisy Fleabane.

In similar localities with the last; frequent. June 15th—August.

505. E. bellidifolius, Muhl. Robin's Plantains.

Moist prairies, banks and copses; common. May—July.

Occasionally the rays are white.

506. E. philadelphicus, L. Common Fleabane.

Open woods, prairies and banks; frequent. June—July 25th. (B.)

PLUCHEA, Cass.**507. P. camphorata, D C. Marsh Fleabane.**

Includes *P. fœtida*, D C.

Rare. July.

Banks of the Desplaines river, near Maywood. Near South Chicago,
Herman Jaeger. (B.)

ANTENNARIA, Gaertn.**508. A. plantaginifolia, Hook. Plantain-leaved Everlasting. Cat's-paw. Mouse-ear.**

Everywhere in dry soil; common, often abundant. March—June.

At Palatine a few young specimens were found with the under side of the leaves green, and nearly free from pubescence.

ANAPHALIS, D C.**509. A. margaritacea, Benth. & Hook. Pearly Everlasting.**

Antennaria margaritacea, R. Br.

Dry open woods and fields; infrequent or rare. July—August. (B.)

A form with broadly ovate, lower leaves is occasionally found in shaded places.

GNAPHALIUM, L. Cud-weed.

- 510.
- G. polycephalum*
- , Michx. Common Everlasting.

Open woods and fields; frequent. August—September.

- 511.
- G. uliginosum*
- , L. Low Cud-weed.

Low grounds along roadsides; not common. August. (B. P.)

INULA, L.

- 512.
- I. helenium*
- , L. Elecampane.

Roadsides and dry banks; infrequent or rare. August. (B.)

The root has a camphoraceous taste and odor. Radical leaves a foot or more long. Stem often very tall, 4 to 7 feet.

POLYMNIA, L.

- 513.
- P. canadensis*
- , L. Leaf-cup.

Shaded ravines north of Evanston; rare, July. Thatcher, east of river; rare, *Babcock*.**SILPHIUM, L.**

- 514.
- S. laciniatum*
- , L. Rosin-weed. Compass-Plant. Pilot or Polar-weed.

Banks and prairies; common. July—August.

The gum that exudes from an injury to this species is sometimes employed as a substitute for chewing gum. •

- 515.
- S. teribinthinaceum*
- , L. Prairie Dock. Rosin-plant.

Prairies; common, especially south. July—October.

The wings of the achenia are sometimes nearly as broad as in *S. laciniata*.

- 516.
- S. trifoliatum*
- , L. Rosin-weed.

Near Thornton, Hill,—in *Plants of Illinois*. (B.)

- 517.
- S. integrifolium*
- , Michx. Rosin-weed.

Open prairies; frequent. August.

- 518.
- S. perfoliatum*
- , L. Cup-plant.

Maywood. On the banks of the Desplaines river, north of Riverside; not common, *Babcock*!**PARTHENIUM, L.**

- 519.
- P. integrifolium*
- , L. Parthenium.

Dry sandy soil; common in the eastern portion of our district, elsewhere infrequent. June 25th—August.

AMBROSIA, Tourn.

- 520.
- A. trifida*
- , L. Great Rag-weed. Horse-weed.

Banks of streams, lakes, swamps, etc.; common. August.

Occasionally 14 feet in height.

A depauperate form occurs with the type, but does not seem to be

Var. *integrifolia*, all the leaves being slightly lobed.

521. *A. artemisiæfolia*, L. Roman Wormwood. Hog-weed. Bitter-weed. Rag-weed.

In waste places; abundant. July 25th—September.
Variable.

522. *A. psilostachya*, D C. Western Rag-weed.

Moist prairies; infrequent. (B.)

Brighton. Hawthorn. Austin. Near Waldheim. Desplaines,
University of Chicago Herb.

XANTHIUM, Tourn.

523. *X. spinosum*, L. Spiny Clobur.

Chicago, Vasey,—in *Plants of Illinois*. (B.)

524. *X. strumarium*, L. Cocklebur. Clobur.

Barn-yards and cultivated grounds; infrequent. August.

525. *X. canadense*, Mill. Cocklebur.

X. strumarium, in part, in Manual, 5th Ed.

Banks of streams and lakes, chiefly in alluvial soil; frequent.
August—September 15th.

A form without pubescence between the prickles is occasionally found.

526. *X. canadense*, Mill., var. *echinatum*, Gray.

X. strumarium, L., var. *echinatum*, Gray.

Sandy soil near the lake shore, Evanston; rare. August.
Whiting, Indiana.

EOLIPTA, L.

527. *E. alba*, Hassk.

E. procumbens, Michx.

Banks of the Calumet river, near L. S. & M. S. R. R. bridge; rare.

July. Observed during the seasons of 1882-'88-'85-'87.

In 1887, a few specimens were found bearing yellowish anthers.

The plants had disappeared from this locality in 1889. (B.)

Seemingly indigenous, but possibly introduced from further east, as this is the only locality in our district from which it has been reported.

HELIOPSIS, Pers. Ox-eye. False Sunflower.

528. *H. lævis*, Pers.

Dry banks, fields and copses; common. July—October.

529. *H. scabra*, Dunal.

H. lævis, Pers., var. *scabra*, T. & G.

With the last; frequent. August—September. (B.)

Achenia slightly pubescent on the angles, the whole plant more or less roughish or hispid.

ECHINACEA, Moench.580. *E. angustifolia*, D C. Purple Cone-flower.

Borders of woods and fence-rows; rare. June—August. (B.)

Glencoe. Maywood. Lake Calumet, 1886. Hinsdale, Du Page County, Babcock.

RUDBECKIA, L. Cone-flower.581. *R. laciniata*, L.

Damp woods and banks; frequent. July 15th—September.

582. *R. triloba*, L.

Dry open woods; infrequent and scattered.

Ravenswood. Near Arlington Heights. Evanston, Johnson. (B.)

The rays of a few specimens collected near Maywood were ovate.

583. *R. subtomentosa*. Ph

Banks of streams and low prairies; frequent. August.

584. *R. hirta*, L. Yellow Daisy. Black-eyed Susan.

Dry soil; abundant. July—September, occasionally as late as November.

A form that is much smoother than the type is occasionally found in moist places.

585. *R. fulgida*, Ait.

South Chicago. I. C. R. R., near Woodlawn, July 4th, 1884. (B. P.)

Evidently introduced from the South.

LEPACHYS, Raf.586. *L. pinnata*, T & G.

Dry banks, prairies and open woods; infrequent. July.

HELIANTHUS, L. Sunflower.587. *H. annuus*, L. Common Sunflower.

This species has escaped from cultivation to some extent, but seemingly does not become established. (B.)

588. *H. rigidus*, Desf.

Dry prairies and fence-rows; infrequent or rare. August. (B.)

589. *H. laetiflorus*, Pers.

Open fields and prairies; not common. August—October.

Usually very rough. A smoother form is occasionally found in the prairies west of Chicago.

540. *H. occidentalis*, Riddell.

Dry prairies and barrens; common southward. July—September.

541. *H. mollis*, Lam.
Sandy soil, mainly in the Calumet Region and southeast; not rare.
August—September.
Occasionally found elsewhere.
542. *H. grosse-serratus*, Martens.
Dry prairies and fence-rows; not common. August—September.
Heads often nearly 4 inches in diameter. A form with almost entire leaves has been noted at Riverside.
543. *H. giganteus*, L.
Wet woods and swamps; not rare. August—September. Mainly south.
The number of rays varies from 12 to 22.
544. *H. giganteus*, L., var. *ambiguus*, T. & G.
Rare.
Near Stony Island, 1884. (B. P.)
545. *H. divaricatus*, L.
Barren places, chiefly south; frequent. July 20th—September. (B.)
546. *H. hirsutus*, Raf.
Dry soil; infrequent. July—August. (B.)
Evanston. Riverside. Englewood. Desplaines. Along the canal near Summit.
Rays usually 10 to 12. Rarely $1\frac{1}{2}$ inches long.
547. *H. strumosus*, L.
Banks of streams and swamps; common. August—September. (B.)
548. *H. strumosus*, L., var. *mollis*, T. & G.
Riverside, near the Desplaines river. Banks of the Calumet. Near Miller's, Ind.; rare. July 1884-'85-'87. Washington Heights, Hill. (B. P.)
549. *H. trachelifolius*, Willd.
Hyde Park and south; not common, *Babcock*!
550. *H. decapetalus*, L.
Banks of streams and low copses; common. August—September.
Rays 9 to 15.
551. *H. tuberosus*, L. Jerusalem Artichoke.
H. doronicoides, in Manual, 5th Ed.
South Chicago, *University of Chicago Herb.* Bottoms of Thorn Creek, near Glenwood, Hill. (B.)

VERBESINA, L.

552. *V. helianthoides*, Michx. Verbesina. Crown-beard.

Actinomeris helianthoides, Nutt.

Near Pullman; rare. Hinsdale, Du Page County; rare, Babcock. (B.)

ACTINOMERIS, Nutt.

553. *A. squarrosa*, Nutt. Actinomeris.

Dry, rich soil; generally distributed but infrequent. August—September. (B).

In moist soil, a form with the stem free from wings is occasionally found.

COREOPSIS, L. Tick-seed.

554. *C. lanceolata*, L.

In damp places; frequent, especially southward. June—July.

555. *C. palmata*, Nutt.

Dry soil; frequent southward, less common elsewhere. June—August.

556. *C. tripteris*, L. Tall Coreopsis.

Rich and rather dry soil; common, at least southward. June—September.

557. *C. trichosperma*, Michx. Tick-seed Sunflower.

Swamps and wet grounds; infrequent. September.

558. *C. trichosperma*, Michx., var. *tenuiloba*, Gray.

In similar localities with the species, but less frequent. (B. P.)

559. *C. aristosa*, Michx.

Moist places; frequent. August—October.

560. *C. aristosa*, Michx., var. *mutica*, Gray.

Near Lake Calumet; rare, 1888. (B.)

BIDENS, L.

561. *B. frondosa*, L. Common Beggar-ticks. Stick-tight.

Moist places; common or abundant. July—September.

562. *B. connata*, Muhl. Swamp Beggar-ticks.

Wet places; common. August—September.

563. *B. connata*, Muhl., var. *comosa*, Gray.

September.

A few specimens were found in 1887 near South Chicago. Colehour, Ind., Hill. (B.)

564. *B. cernua*, L. Smaller Bur-Marigold.

Swamps and wet places; frequent. August—September. (B)

Within our limits the rays are often more prominent in those forms growing in shaded places, and on the earlier flowers.

565. *B. chrysanthemoides*, Michx. Larger Bur-Marigold.

Swamps and wet places; common, occasionally abundant. August—October,—in 1887 as late as November.

Probably confined to the eastern portion of our district.

566. *B. beckii*, Torr. Water-Marigold.

In shallow water, Lake Calumet, 1884-'86. Desplaines river, *University of Chicago Herb.* Near Miller's, Ind., infrequent, August.

Calumet river, near South Chicago, 1887, *Hill*!

The lower leaves may be mistaken for those of *Ranunculus aquatilis*, L. (B.)

GALINSOGA, Ruiz & Pavon.

567. *G. parviflora*, Cav. Galinsoga.

Chicago, August, 1886, *Bastin*. (B. P.)

HELENIUM, L.

568. *H. autumnale*, L. Sneezeweed.

Banks of streams and wet places; common. August—September.

DYSODIA, Cav.

569. *D. chrysanthemoides*, Lag. False Dog-Fennel.

Adventive on I. C. R. R.; common near crossing of L. S. & M. S.

R. R.; rare near 22nd St. Station, *Babcock*!

ANTHEMIS, L.

570. *A. cotula*, D C. May-weed. Dog-Fennel. *Mather*.

Maruta cotula, D C.

Roadsides and waste grounds; abundant. July 15th—November.

571. *A. arvensis*, L. Corn or Field Chamomile.

Old and waste fields; rare. July. (B. P.)

Seemingly established near Evanston, and in a few places in the northwestern part of the county, near Palatine.

ACHILLEA, L.

572. *A. millefolium*, L. Common Yarrow or Milfoil.

Fields, roadsides, etc.; common, occasionally abundant in the northern and western portions of the district. June—October.

The rose colored form is reported from Winnetka; frequent at Riverside, Palatine and Maywood.

CHRYSANTHEMUM, Tourn.

573. *C. LEUCANTHEMUM*, L. White-weed. Ox-eye or White-Daisy. Marguerite.

Leucanthemum vulgare, Lam.

Railroad banks and dry fields; infrequent. September.

Along the Wisconsin division of the C. & N. W. R. R. to the limits of the county. From South Chicago southeast, along the L. S. & M. S. R. R.; frequent. Becoming more common each season, in spite of those who collect it for its beauty and for sale.

A common and noxious weed in the East.

574. *C. PARTHENIUM*, Pers. Feverfew.

Leucanthemum parthenium, Godron.

Matricaria parthenium, L.

Sparingly escaped from cultivation at Evanston. (B. P.)

TANACETUM, L.

575. *T. VULGARE*, L. Common Tansy.

Escaped from cultivation to roadsides; common only locally and in only a few localities. July—August.

Glencoe. Miller's, Ind. Maywood. Banks of Lake Calumet, *Bastin*.

ARTEMESIA, L. Wormwood.

576. *A. caudata*, Michx.

Sandy soil of the lake shore; rare. August. (B.)

Evanston. Lake Calumet. Short distance north of Cheltenham Beach, 1888-'85-'87. Englewood, *Dodge*.

This species may be found more frequently.

577. *A. canadensis*, Michx. Sea Wormwood.

Along the lake shore, both north and south; frequent. August. (P.)
A pubescent form is not infrequent.

578. *A. ludoviciana*, Nutt. Western Mugwort.

The form with undivided leaves—var. *gnaphalodes*, of Gray's Manual, 5th Ed.—has been found in sandy soil along the lake shore from Jackson Park to the county line, and south in Indiana to Miller's. From this locality but a half-dozen specimens have come to our knowledge, collected during the years 1884-'86. (B.)

579. *A. biennis*, Willd. Biennial Wormwood.

Dry open grounds; common. July—August.

SENECIO, Tourn.

580. *S. aureus*, L. Golden Ragwort. Squaw-weed. Groundsel.

Shaded swamps and wet places; common or abundant. May—July.

581. *S. aureus*, L., var. *obovatus*, T. & G.

Moist prairies and shaded places; not common. June. (B.)

582. *S. aureus*, L., var. *balsamitæ*, T. & G.

Dry banks and occasionally in fields; frequent, more common in the northwestern portion of our district. June. (B.)

CACALIA, L.583. *C. suaveolens*, L. Indian Plantain.

Moist rich woods; very rare. September, 1885-'87.

Near Casella, Ind. (B.)

584. *C. atriplicifolia*, L. Pale Indian Plantain.

Near Riverside; rare. August. Desplaines river, near Maywood, Babcock. Sandy woods, Hammond, Ind., Hill.

585. *C. tuberosa*, Nutt. Tuberous Indian Plantain.

Moist prairies; common. June—July.

The leaves are either smooth or slightly pubescent, the latter when in drier soil.

ERECHTHITES, Raf.586. *E. hieracifolia*, Raf. Fire-weed.

Moist open woods and clearings; frequent. July 20th—September, occasionally as late as November.

It is liable to occur in new localities when the soil is disturbed or timber removed.

ARCTIUM, L.587. *A. LAPPÆ*, L. Common Burdock.

Lappa officinalis, Allioni.

Including var. *majus*, Gray.

In waste places; common, often abundant. July—October.

588. *A. LAPPÆ*, L., var. *minus*, Gray.

Lappa officinalis, Allioni, var. *minor*, Gray.

With the type. (B. P.)

ONICUS, Tourn. (Circium, D C.)589. *C. LANCEOLATUM*, Hoffm. Common Thistle.

Fields, roadsides and waste places; common or abundant. July—September.

590. *C. pitcheri*, Torr. Pitcher's Thistle.

Sandy soil of the lake shore, both north and south; quite frequent in Lake County, Ind. June—July.

591. *C. undulatus*, Gray. Thistle.

Pine Station, north to Colehour, Ind.; rare.

Plants usually not very canescent, only whitish; 1 to 2 feet high; heads generally single; not very common, Pine Station, Ind., *Hill*. (B. P.)

This form does not have the true characteristics of *C. undulatus*, and may possibly be a variety of *C. pumilus*. We place it here provisionally.*

592. *C. altissimus*, Willd. Tall Thistle.

Fields and newly-cleared lands and in open woods; frequent. August.

593. *C. altissimus*, Willd., var. *discolor*, Gray.

C. discolor, Spreng.

With the type, especially southeast; frequent. July—August.

594. *C. muticus*, Ph. Swamp Thistle.

Swamps, wet fields and banks; frequent, especially southward. July 15th—September.

In drier soil it seldom attains a height of more than two feet.

595. *C. ARVENSIS*, Hoffm. Canada Thistle.

Prairies and waste places; common or abundant. July—September. Along some of the streets in the outskirts of Chicago, it attains a height of 3 to 4 feet; on the open prairies, it is usually not over 6 inches. Much branched. Flowers often very pale rose-color, and a specimen near Garfield Park bore nearly white heads.

CENTAUREA, L.

596. *C. CYANUS*, L. Bluebottle. Bachelor's Button.

Escaped from cultivation at Evanston and Barrington, and is seemingly well established. July. (B. P.)

KRIGIA, Schreb.

597. *K. virginica*, Willd. Krigia. Dwarf Dandelion.

Sandy soil; rare. April—July.

Colehour, Ind., 1884–86. Miller's, Ind., July, *Bastin, Hill*. Lake, Ind., *Babcock*.

598. *K. amplexicaulis*, Nutt. Cynthia.

Cynthia virginica, Don.

Rich and moist fields and banks; frequent. June.

*Since the above was written, specimens have been sent to Mr. Canby, who considers it a new species, naming it *C. hillii*, in honor of Prof. E. J. Hill, who first made a critical study of the form. See Appendix I.

CICHORIUM, Tourn.599. *C. INTYBUS*, L. Chicory.On C. & N. W. R. R., east of Harlem, *Babcock*. (P.)**TRAGOPOGON**, L.600. *T. FORRIFOLIUS*, L. Oyster-plant. Salsify. Jerusalem Star.

Sparingly escaped cultivation, but apparently not established, at Evanston, 1887. (B. P.)

601. *T. PRATENSIS*, L. Goat's-beard. Joseph's-flower.

In 1888 a half-dozen specimens were found on Greenwood Boulevard, Evanston, and a few near South Evanston, on the lake shore. (B. P.)

HIERACIUM, Tourn.602. *H. canadense*, Michx. Canada Hawkweed.

Open woods and dry banks; infrequent. August—September. (B.)

603. *H. paniculatum*, L. Hawkweed.

Dry woods; infrequent. August. (B.)

Specimens not more than 6 inches in height are quite often found in barren places.

604. *H. venosum*, L. Rattlesnake-weed.

Sandy soil; infrequent, chiefly south. July—August.

West of Berry Lake, Ind. Near Miller's, Ind. Normal Park, *Brennan*. (B. P.)605. *H. scabrum*, Michx. Rough Hawkweed.

Dry open woods and shaded places; frequent. August. (B.)

606. *H. gronovii*, L. Hairy Hawkweed.

Sandy soil; not common. August. (B.)

Hammond, Ind., *Hill*.607. *H. longipilum*, Torr. Long-bearded Hawkweed.

Open woods, near Stony Island; rare. (B.)

Evanston. Pine Station, Ind. Miller's, Ind., *Bastin*.**PRENANTHES**, Vaill. Rattlesnake-root.608. *P. racemosa*, Michx.*Nabalus racemosus*, Hook.

Moist places, south; infrequent. August.

Hyde Park. Banks of the Desplaines river.

609. *P. aspera*, Michx.*Nabalus asper*, T. & G.

Prairies and banks in dry soil; infrequent. August. (B.)

610. *P. alba*, L. White Lettuce.*Nabulus albus*, Hook.

Rich open woods and fence-rows in sandy soil; common. August—September.

611. *P. altissima*, L. Tall White Lettuce.*Nabulus altissimus*, Hook.

Rich woods. September. (B.)

Whiting and Pine Station, Ind. Glencoe, Johnson. Stem 2 to 4 feet high, Whiting, Ind., Hill.

TARAXACUM, Haller.612. *T. officinale*, Weber. Common Dandelion. Priest's Crown.*T. dens-leonis*, Desf.

Everywhere abundant, less common in moist or prairie lands. March—November.

LACTUCA, Tourn.618. *L. scariola*, L. Prickly Lettuce.

Roadsides and door-yards; infrequent. July—September. (B. P.)

614. *L. canadensis*, L. Wild Lettuce. Trumpet Milk-weed. Fire-weed.

Rich and damp soil in uncultivated portions of fields, fence-rows, borders of woods, etc.; common. July—September.

Flowers purplish.

615. *L. acuminata*, Gray. False Lettuce.*Mulgedium acuminatum*, D C.

Borders of woods; infrequent or rare. August. (B.)

Evanston. Near Whiting, Ind., 1884-'85.

616. *L. leucophæa*, Gray. False Lettuce.*Mulgedium leucophæum*, D C.

Low grounds, borders of woods, etc.; frequent. July—Sept. (B.)

617. *L. leucophæa*, Gray, var. *integrifolia*, Gray.

Rare. August, 1887-'88. (B. P.)

Near Kensington.

SONCHUS, L.618. *S. oleraceus*, L. Common Sow-thistle.

Waste places near cultivated or rich soil; infrequent. August—September. (B.)

619. *S. ASPER*, Vill. Sow-thistle.
With the last, but possibly more common. August—September.
620. *S. ARVENSIS*, L. Field Sow-thistle.
By P. Ft. W. & C. R. R., Englewood, Hill. (B. P.)

LOBELIACEÆ.

LOBELIA, L. Lobelia.

621. *L. cardinalis*, L. Cardinal-flower.
Swampy places and low grounds; common locally. July—September.
A form with white flowers is occasionally found in the Calumet Region.
622. *L. syphilitica*, L. Great Lobelia.
Low grounds; common, locally abundant. August.
A white-flowered form is occasionally found near Niles. Flowers often purple or purplish.
623. *L. puberula*, Michx.
Ravenswood and north in sandy soil; infrequent. South Chicago, University of Chicago Herb. (B.)
624. *L. spicata*, Lam.
Sandy soil; frequent. June—August.
625. *L. kalmii*, L. Kalm's Lobelia.
Damp sandy banks; frequent. August—September.
Chiefly near the lake shore. South Chicago; common. Rogers Park; rare.
626. *L. inflata*, L. Indian Tobacco.
Prairies, open woods and dry fields; infrequent. July—September.

CAMPANULACEÆ.

SPECULARIA, Heister.

627. *S. perfoliata*, A. D C. Venus' Looking-glass.
Dry and sterile fields, etc.; infrequent or rare. June—July.
Riverside; rare, Babcock!

CAMPANULA, Tourn.

628. *C. rotundifolia*, L., var. *arctica*, Lange. Hairbell. Bluebell.
Lady's-thimble.
C. rotundifolia, var. *linifolia*, in Manual, 5th Ed.
Bluffs on lake shore, both north and south; frequent south, rare north. June—August.

629. *C. aparinoides*, Ph. Marsh Bellflower.

Wet prairies and meadows; common. June—August

A large flowered form, with the corolla about 8 lines in length, is occasionally found in the Calumet Region.

630. *C. americana*, L. Tall Bellflower.

Moist open woods and wet shaded banks; frequent south, infrequent or rare elsewhere. July—August.

A branching form, 5 to 7 feet tall, has been occasionally noted in the rich open woods near Riverside.

ERICACEÆ.

GAYLUSSACIA, H. B. K.

631. *G. resinosa*, T. & G. Common Black Huckleberry.

In sandy soil; infrequent, more common south. May—July.

Near the lake shore, both north and south. Evanston. Rose Hill. Vicinity of Glencoe, *Babcock*.

Near Pine Station, Ind., two forms occur:

(a) Stem much branched, rigid, glabrous; leaves oval to rather broadly lanceolate, obtuse; racemes with from 4 to 8 flowers; corolla, less than 4 lines long; fruit black, rarely whitish; flowers in May or early June. The typical form.

(b) Stem but little branched, 2 feet high, pubescent, somewhat in lines; leaves oval, oblong, slightly resinous, mucronulate; racemes 6 flowered; corolla about 4 to 5 lines long; fruit blue-black; flowers in June; rare.

VACCINIUM, L.

632. *V. pennsylvanicum*, Lam. Dwarf or Low Blueberry. Huckleberry.

Sandy soil in open woods and on hillsides; infrequent from Hyde Park southward. April—June.

A second set of flowers is often produced in September.

The following forms grow at Hammond, Ind., *Hill*:

(a) Leaves glaucous; fruit black, without bloom; somewhat depressed globular; usually taller than the type!

(b) 8 to 15 inches high; leaves of a larger form, glaucous; flowers tinged with red.

(c) 8 to 15 inches high; leaves glaucous, narrow; flowers as in *b*.

(d) 8 to 15 inches high; leaves green, generally broader; flowers white!

(e) 4 to 8 inches high; leaves green, narrow; flowers white!

(f) 4 to 8 inches high; leaves glaucous; flowers nearly white.

688. *V. canadense*, Kalm. Canada Blueberry.

Swamps; apparently rare.

Near borders of Lake Calumet, 1882-'87. Egondale, 1886. Thornton, Hill. (B.)

This species is so easily mistaken for *V. pennsylvanicum*, Lam., collections from low swamp regions, should be examined with care.

684. *V. vacillans*, Solander. Low Blueberry.

Dry sandy woods, south; infrequent. May—June. (B.)

Clarke, Ind. Bluffs east of Cassella, Ind. Thornton, Hill. Miller's, Ind., Bastin.

685. *V. corymbosum*, L. Swamp or High Blueberry. Huckleberry.

Borders of swamps, especially south; frequent. May. (B.)

Specimens of this species thus far found, show that it is very variable.

The following forms are found at Miller's, Ind., Hill:

(a) With siliate-serrulate leaves, pubescent, mainly on the veins beneath, pale, especially beneath, and sometimes glomerate-ciliate.

(b) With leaves nearly or quite entire, margins ciliate, smooth, or occasionally pubescent on the midrib beneath, longer, green and glossy both sides, when young, pubescent in lines!

(c) With leaves serrate-crenate without ciliæ, smooth.

686. *V. corymbosum*, L., var. *glabrum*, Gray.

With leaves entire, except with slight inclination to be serrulate at the tip in some cases; smooth, pale beneath; green and glossy above, Miller's, Ind., Hill! (B. P.)

687. *V. corymbosum*, L., var. *amœnum*, Gray.

Miller's, Ind., Hill! (B. P.)

With ciliate-serrulate leaves, nearly or quite without pubescence, and often nearly without ciliæ.

688. *V. corymbosum*, L., var. *pallidum*, Gray.

Wet thickets.

Miller's, Ind., Hill! (B. P.)

689. *V. macrocarpon*, Ait. Large American Cranberry.

Swamps and open bogs near the lake shore, both north and south; infrequent north, common south. June—August.

ABTOSTAPHYLOS, Adans.**640. A. uva-ursi**, Spreng. Bearberry Kinnikinnick.

Barrens and sandy places; rare, except locally. May—July.

Formerly found at the foot of Greenwood Boulevard, Evanston. In 1886 a few specimens were collected near Windsor Park, and near Lakeside in 1884. Quite common in the barrens from Miller's, Ind., north to South Chicago. Found sparingly near the Reform School, Babcock.

GAULTHERIA, Kalm.**641. G. procumbens**, L. Creeping Wintergreen. Checkerberry. Teaberry.

On the sand bluffs and barrens from Colehour south, under the evergreens, it is quite common. Niles woods; rare, *Miss G. A. Raddin*.

CASSANDRA, Don.**642. C. calyculata**, Don. Leather-leaf.

Borders of sandy sloughs, Lake County, Ind.; common. April 25th—July. (P.)

RHODODENDRON, L.**648. R. nudiflorum**, Torr. Purple or Pink Azalea. Pinxter-flower.

Azalea nudiflora, L.

A single specimen was found in May, 1886, in damp woods, not far from the north end of Lake Calumet. The shrub was about 5 feet high; the flowers were mainly pink; stamens 10. This locality was cleared in 1887, and the shrub destroyed. (B.)

Epigaea repens, L., is found near Michigan City, Ind., on the sand hills, also three miles north of Porter's, Ind., at the mouth of West City Creek; this is twelve miles southeast of our limits, *Hill*.

CHIMAPHILA, Ph.**644. C. umbellata**, Nutt. Prince's Pine. Wintergreen.

Dry woods, both north and south, near the lake shore; infrequent, more common south. June—July 15th.

645. C. maculata, Ph. Spotted Wintergreen.

Pine woods, Edgemoor, Ind., *Hill*! (B. P.)

PHYLOA, Tourn.**646. P. secunda**, L. Wintergreen. Shin-leaf.

Clarke, Ind., *University of Chicago Herbarium*. Miller's and Pine Station, Ind.; rare, *Babcock, Bastin*! (P.)

647. P. chlorantha, Swartz.

Open woods in sandy soil from Whiting, Ind., southeast; infrequent. June. (B.)

648. *P. elliptica*, Nutt.

Rich woods; infrequent, but generally distributed. June 25th—July.
 Glencoe. South Evanston. Hyde Park. Riverside. Egondale.
 Desplaines. Calumet Region. Miller's and Pine Station, Ind.
 Flowers were found as late as September in 1887.

649. *P. rotundifolia*, L. False Wintergreen.

Woods, on sand ridges and borders of sloughs; infrequent, from
 Pine Station, Ind., south to limits. June 25th—July. (B. P.)

650. *P. rotundifolia*, L., var. *asarifolia*, Hook.

P. asarifolia, Michx.

Woods near Miller's, Ind.; rare. June, 1886. (B. P.)

MONOTROPA, L.651. *M. uniflora*, L. Indian Pipe. Corpse-Plant.

Rich woods; rare. July.

Wilmette. Lamont. Berry Lake, Ind. Woods of the Calumet
 Region. Glencoe and Riverside, *Babcock*!

A specimen found near Lamont had 10 perfect stamens, and 2,
 seemingly rudimentary, without anthers.

PRIMULACEÆ.**DODECATHEON**, L.652. *D. meadia*, L. American Cowslip. Shooting-Star.

Fields, roadsides, etc.; common, often abundant. May—July.

White flowered forms are quite common; four merous forms are
 very rare.

TRIENTALIS, L.653. *T. americana*, Ph. Star-flowered Chickweed. Chickweed-
Wintergreen.

Damp woods; frequent south, rare south and west. May—June
 15th. (P.)

Miller's, Ind., frequent.

STEIRONEMA, Raf. Loosestrife.654. *S. ciliatum*, Raf.

Lysimachia ciliata, L.

Low prairies and woods, banks of streams, etc.; common. June—
 July.

655. *S. lanceolatum*, Gray.

Lysimachia lanceolata, Walt.

Swampy places, damp open woods and fields; frequent or common.
 June—July.

656. *S. lanceolatum*, Gray, var. *hybridum*, Gray.

Lysimachia lanceolata, Walt., var. *hybrida*, Gray.

L. hybrida, Michx.

With the type; rare. July. (B. P.)

Hyde Park. Englewood, *Bastin*.

657. *S. longifolium*, Gray.

Lysimachia longifolia, Ph.

Banks of streams, moist places, fence-rows, etc.; common or abundant. July—September.

LYSIMACHIA, Tourn. Loosestrife.

658. *L. quadrifolia*, L.

Banks of streams and low sandy grounds; apparently infrequent or rare. June. (B. P.)

659. *L. stricta*, Ait.

Swamps and low places; infrequent. June—August, often as late as September.

660. *L. nummularia*, L. Moneywort.

Sparingly escaped from cultivation at Evanston. July—August. (B. P.)

661. *L. thyrsoflora*, L. Tufted Loosestrife.

Naumburgia thyrsoflora, Moench.

Swamps and sloughs from Hyde Park, southward; infrequent. May—June.

Style frequently protruding before the flower opens, *Hill*

SAMOLUS, Tourn.

662. *S. valerandi*, L., var. *americanus*, Gray. Brook-weed. Water-Pimpernel.

Wet sandy banks; infrequent. June—August.

Calumet Region. Thatcher; rare, *Babcock*.

OLEACEÆ.

FRAXINUS, Tourn.

663. *F. americana*, L. White Ash.

Rich and usually low woods; frequent. April—May.

664. *F. pubescens*, Lam. Red Ash.

Banks of Lake George, near Whiting, Ind., July, *Hill*. Banks of Berry Lake, Ind., in May, 1886; a single tree. (B.)

665. *F. viridis*, Michx.f. Green Ash.

Banks of the Desplaines river, near Maywood. Banks of streams and lakes southeast; infrequent or rare. May. (B.)

666. *F. sambucifolia*, Lam. Black Ash.
Swamps from Grand Crossing, south and southeast; infrequent.
April—May. (B.)

APOCYNACEÆ.

APOCYNUM, Tourn.

667. *A. androssæmifolium*, L. Spreading Dogbane.
Borders of woods, fence-rows and copses; common. June 25th—
August 10th.
Two forms occur:
(a) Glabrous; common.
(b) Tomentose, especially on the under side of the leaves; rare.
668. *A. cannabinum*, L. Indian Hemp.
Banks of streams, borders of woods, moist roadsides, etc.; common.
July—August.
Polymorphous. The various forms can hardly be considered varieties. Specimens have been found in the Calumet Region that were 5 feet high. Prostrate forms occur in dry places.

ASCLEPIADACEÆ.

ASOLEPIAS, L. Milkweed.

669. *A. tuberosa*, L. Butterfly-weed. Pleurisy-root. Indian Posy.
Sandy soil; frequent or common in the eastern portion of our district, especially southeast, in Lake County, Ind. August.
Specimens sometimes attain a height of 3 feet, and have deep orange-red flowers.
670. *A. purpurascens*, L. Purple Milkweed.
Dry banks, borders of woods and copses; not common. June 15th—
July.
Chiefly from Riverside and Hyde Park southeast.
This species often reaches a height of 4 to 5 feet.
671. *A. incarnata*, L. Swamp Milkweed.
Swamps, wet banks and fields; common, or abundant south. July
672. *A. incarnata*, L., var. *pulchra*, Pers.
With the type; infrequent. June—July. (B. P.)
673. *A. cornuti*, Decaisne. Common Milkweed. Silkweed.
Fields, bluffs and roadsides; common or abundant. July—August.
It is said that silk fabric is successfully made from the long silky hairs of the seeds.
674. *A. sullivantii*, Engelm. Sullivan's Milkweed.
Moist or swampy places; frequent, especially southward. July.

675. *A. obtusifolia*, Michx.
Sandy soil, east; infrequent or scattered. June—July.
676. *A. phytolaccoides*, Ph. Poke Milkweed.
Moist shaded banks, open woods and copses; infrequent or rare.
June 15th—July.
Rogers Park. North of Lincoln Park and west to limits. River-
side. South Chicago. Grand Crossing and south.
677. *A. ovalifolia*, Decaisne.
Near Stony Island; very rare, two specimens were found in 1886.
Ravenswood. Glencoe. (B.)
678. *A. quadrifolia*, L. Four-leaved Milkweed.
Borders of woods; rare. June. (B.)
Maywood. East of Woodlawn, 1887.
679. *A. verticillata*, L. Whorled Milkweed.
Dry sandy soil; bluffs and hills of the eastern portions; infrequent,
more common on sand hills, southeast.
- ACERATES**, Ell. Green Milkweed.
680. *A. longifolia*, Ell.
South Evanston; infrequent. Riverside and Hyde Park; common,
Babcock! Calumet; moist places, *C. P. Murry*. Clarke, Ind.,
Bastin!
681. *A. viridiflora*, Ell.
Dry grounds throughout the eastern portion of our district; infre-
quent and scattered. July—August.

GENTIANACEÆ.

SABBATIA, Adans.

682. *S. angularis*, Ph. American Century.
Rich and dry sandy soil, near the sloughs, southeast; frequent.
Abundant on shores of sandy sloughs at Miller's, Ind., *Babcock!*

GENTIANA, Tourn.

683. *G. crinita*, Froel. Fringed Gentian.
Low grounds; frequent or common, locally. August—October.
684. *G. serrata*, Gunner. Smaller-fringed Gentian.
G. detonsa, Frees.
North, it is frequently found with *G. crinita* in moist places; fre-
quent south, less frequent elsewhere. August—October.

685. *G. quinqueflora*, Lam. Five-flowered Gentian.
Rather moist gravelly banks and wooded ravines; infrequent, and mainly from Riverside northward. August 15th—September.
686. *G. puberula*, Michx. Gentian.
Dry prairies; Ravenswood and vicinity; frequent. Grand Crossing and Woodlawn. Norwood Park. Palatine; rare, 1886. Barrens southeast; infrequent or rare. Hyde Park; not common, *Babcock!* August.
687. *G. saponaria*, L. Soapwort Gentian.
Dry banks; Lake Bluff, Lake County, Ills., *Herman Jaeger*. Pine Station, Ind. Miller's, Ind., in damp ground, *Hill*. Thornton, *Hill*,—in *Plants of Illinois*. (B.)
688. *G. andrewsii*, Griseb. Closed Gentian. Cloistered Heart.
Wet fields, ditches and banks; common. August—October.
The white-flowered form has been found in rich shaded soil at Riverdale and Desplaines.
689. *G. alba*, Muhl. Whitish Gentian.
Low grounds and open woods, glades, etc. August—September 10th, occasionally in July.
Southeast from Grand Crossing and South Chicago. Riverside; rare, *Babcock!*
- BARTONIA**, Muhl.
690. *B. tenella*, Muhl.
South Evanston, in one locality it is quite common. August. (B.)
Miller's, Ind., *Bastin!* Borders of sloughs near Tolleston, and Miller's, Ind., associated with *Nyssa sylvatica*, *Marsh.*, *Hill!*

MENYANTHES, Tourn.

691. *M. trifoliata*, L. Buck-bean.
Bogs and wet places; not common, except locally. May—June.
Riverside. Hyde Park, south and southeast.

POLEMONIACEÆ.

PHLOX, L. Phlox.

692. *P. paniculata*, L.
Rich woods and damp shaded banks; not common, except locally. June. (B.)
Glencoe. Niles. Riverside.
An area of several square feet near Berry Lake, Ind., was annually covered with the white-flowered form until the season of 1889, when the locality was cleared and ploughed.

693. *P. maculata*, L. Wild Sweet-William.

Rich woods and banks of streams; not common. June. (B.)
Glencoe. Niles. Maywood. Riverside.

694. *P. glaberrima*, L.

Prairies and open rich woods, south; frequent. July.
Our specimens usually have a rose-red corolla.

695. *P. pilosa*, L. Hairy Phlox.

Prairies and open woods; common or abundant. May—July.
During the season of 1885, nearly all specimens examined were
smooth. The white-flowered form is quite frequent.

696. *P. divaricata*, L.

Rich and damp open woods and banks; frequent. May—June.
Common in the Calumet Region and at Riverside.

Two forms occur:

- (a) Petals slightly obcordate, lilac or bluish; leaves chiefly ovate,
or ovate-lanceolate.
- (b) Petals entire, or only slightly emarginate, lilac, bluish or
nearly white; leaves frequently lanceolate.

697. *P. bifida*, Beck.

Sandy soil of the eastern portion of our district; common, especially
southward. May—June.
Plant slightly pubescent, rarely nearly or quite smooth.

POLEMONIUM, Tourn.

698. *P. reptans*, L. Greek Valerian.

Rich woods and damp shaded banks; frequent locally. May—June.
In very rich and damp woods the corolla is often a deep blue.

HYDROPHYLLACEÆ.

HYDROPHYLLUM, Tourn. Waterleaf.

699. *H. macrophyllum*, Nutt.

Rich woods; rare. June 25th—July. (B.)
Niles. Bowmansville.

700. *H. virginicum*, L.

Damp woods throughout our district, especially in ravines of the
northwest; frequent. May 20th—June.

701. *H. appendiculatum*, Michx.

Rich and damp woods, especially in ravines; infrequent. June—
July. (B.)
The reflexed appendages of the calyx vary from $\frac{1}{4}$ to $\frac{1}{2}$ inch in
length.

ELLISIA, L.**702. *E. nyctelea*, L. *Ellisia*.**Includes *E. ambigua*, Nutt.

Banks of the Desplaines river and streams of the Calumet Region; frequent. In damp places elsewhere; infrequent or rare. May—August.

BORRAGINACEÆ.**CYNOGLOSSUM, Tourn.****708. *C. officinale*, L. Common Hound's-tongue.**

Waste grounds, etc.; common. May—July.

A white form is occasionally found.

The nutlets of the early flowers are often quite or absolutely smooth; usually they are simply rough.

704. *C. virginicum*, L. Wild Comfrey.

Prairies near Hawthorn; rare, 1886. Open woods in the northern part of our district; infrequent. June—July. (B.)

ECHINOSPERMUM, Lehm.**705. *E. virginicum*, Lehm. Beggar's Lice. Stickseed. Stick-tight. Beggar-tick.***Cynoglossum morisoni*, D C.

Open woods and copses; common. July—August.

706. *E. laffula*, Lehm. Stick-seed.

Waste places, and as a weed in gardens; common. July—August.

MERTENSIA, Roth.**707. *M. virginica*, D C. Blue-bells. Smooth Lungwort. Virginian Cowslip.**

May be found established along roadsides, having escaped cultivation.

Riverside, *Babcock*! North branch Chicago river, *Bastin*. Blue Island, *Dodge*.

MYOSOTIS*, Dill.**708. *M. verna*, Nutt. Forget-me-not.**

South Evanston and northward; rare. May 25th—June.

Riverside; rare, *Babcock*. Normal Park; not common, *Brennan*. Englewood; dry ground, *Hill*.

LITHOSPERMUM, Tourn.**709. *L. arvense*, L. Corn Gromwell.**

Sandy soil; infrequent. April 25th—July. (B.)

**M. palustris*, With., is frequently cultivated, and may be found in wet places, adjacent to gardens.

710. *L. latifolium*, Michx. Broad-leaved Gromwell.
 Rich open woods and shaded banks; infrequent. June. (B.)
 North branch Chicago river. Riverside. Maywood. Casella, Ind.
711. *L. hirtum*, Lehm. Hairy Puccoon.
 In sandy soil; common, especially on the sand dunes or ridges
 southeast April—July, occasionally as late as September.
 With dimorphous flowers, open sandy woods, Englewood, Hill.
 Both the forms mentioned by Dr. Gray in his Synoptical Flora of
 North America, occur here:
 (a) Form with the stamens inserted in the middle of the corolla,
 and the style rising to the throat.
 (b) Form with the style rising to the middle, and the stamens in
 the throat.
712. *L. canescens*, Lehm. Hoary Puccoon. Alkanet.
 Prairies and open woods, in sandy soil; abundant, especially east-
 ward. April—June.
713. *L. angustifolium*, Michx. Narrow-leaved Gromwell.
 Includes *L. longiflorum*, Spreng.
 Sandy soil on hillsides, banks of streams, prairies, and dry open woods.
 A rather local species producing cleistogamous blossoms all summer.
- ONOSMODIUM**, Michx.
714. *O. carolinianum*, D C. False Gromwell.
 Calumet river; rare, 1887, a single specimen. Banks of the Des-
 plaines river; infrequent. July. (B.)
715. *O. carolinianum*, D C., var. *molle*, Gray. False Gromwell.
O. molle, Michx.
 Dry ground; Evanston, Boltwood. (B.)

CONVOLVULACEÆ.

IPOMŒA, L.

716. *I. coccinea*, L. Cypress-vine.
Quamoclit coccinea, Moench.
 Wild on sand banks; Englewood, Hill. (B.)

717. *I. pandurata*, Meyer. Wild Potato-vine.
 Riverside; rare, Babcock!

CONVOLVULUS, Tourn.

718. *C. spithameus*, L. Bracted Bindweed.
Calystegia spithamea, Ph.
 Dry sandy soil, mostly in the eastern portion of our district; not
 common. June. (B.)

719. *C. sepium*, L. Hedge Bindweed.*Calystegia sepium*, R.Br.Moist banks, woods, prairies, etc., mostly in alluvial soil; common.
June—August.720. *C. sepium*, L., var. *americanus*, Sims.

With the type. (B. P.)

721. *C. sepium*, L., var. *repens*, Gray.*Calystegia sepium*, R.Br., var. *pubescens*, Gray.

With the type; frequent. July—August. (B. P.)

722. *O. arvensis*, L. Bindweed.Near South Evanston; rare, July, 1887. Pine Station, Ind., *Bastin*,
Hill. (B. P.)**CUSCUTA**, Tourn. Dodder.723. *C. chlorocarpa*, Engelm.On *Polygonum lapathifolium*, L., var. *incarnatum*, Watson., near
the outlet of Lake Calumet; rare, June, 1885. (B.)On *Euphorbia*, *Aster* and *Fragaria*, at Miller's, Ind., *Hill*! On
Solidago, Colehour, Ind.724. *C. gronovii*, Willd.Banks of streams, rich open woods, etc.; frequent. August—
September.Mostly on Compositæ and *Polygonum*.

Two forms occur:

(a) Flower 5-merous; common.

(b) Flower 4-merous; rare.

725. *C. glomerata*, Choisy.

In rich and damp soil; rare. July—August. (B.)

Mostly on *Helianthus*.

Niles. Riverside. Berry Lake, Ind.

SOLANACEÆ.**SOLANUM**, Tourn.726. *S. dulcamara*, L. Bittersweet.

In waste places near dwellings. July. (B.)

Evanston. South Chicago.

727. *S. nigrum*, L. Common Nightshade.

Waste places and dry fields; common. July—September.

728. *S. carolinense*, L. Nightshade. Horse-nettle.
South Chicago. Colehour, Ind., July. Near Union Stock Yards,
Babcock. Grand Crossing, *Bastin*!
729. *S. CAROLINENSE*, L., var. *FLORIDANUM*, Chap.
By Ft. Wayne R.R., near Englewood, *Hill*.
Mainly a form with deep-lobed leaves,—*Gray's Synoptical Flora of*
North America. (B. P.)
730. *S. rostratum*, Dunal. Nightshade.
Tolleston, Ind., on Ft. Wayne R.R., near Calumet bridge, *Hill*.
South Chicago, August, 1886, *A. B. Martin*. Dune Park, Ind.,
1890. (B.)

PHYSALIS, L.

731. *P. virginiana*, Mill. Ground Cherry.
P. viscosa, in *Manual*, 5th Ed.
Dry and sandy soil; common. July—September.
732. *P. lanceolata*, Michx. Ground Cherry.
P. pennsylvanica, in *Manual*, 5th Ed.
Dry places, usually in sandy soil; frequent. July—September.

DATURA, L.

733. *D. stramonium*, L. Stramonium. Thorn-Apple.
Old fields and waste grounds around dwellings and roadsides; fre-
quent. August—September.
734. *D. tatula*, L. Purple Thorn-Apple.
Evanston; a single specimen, August, 1882.
Apparently a waif. (B.)

NICOTIANA, Tourn.

735. *N. rustica*, L. Wild Tobacco.
Old and dry fields, near Evanston; rare, August, 1882.
Supposed to be a relic of Indian cultivation. (B. P.)

SCROPHULARIACEÆ.

VERBASCUM, L.

736. *V. thapsus*, L. Common Mullein. Shepherd's Club.
Dry fields, banks and roadsides; common, often abundant. June
15th—August, rarely as late as November.
The white-flowered form is rarely found. In 1887, it was quite
common in the fields around South Chicago, and northward to
Woodlawn.

787. *V. BLATTARIA*, L. Moth Mullein.

Evanston, 1885, rare. Whiting, Ind. Cassella, Ind., *Hill*. (B.)

LINARIA, Tourn.

788. *L. canadensis*; Dumont. Wild Toad flax.

Sandy soil; frequent in the eastern portion of our district. May—July. (B.)

789. *L. VULGARIS*, Mill. Toad-Flax. Butter-and-Eggs. Ramsted. Rancid. Old fields, banks and roadsides; frequent, locally common. June—September.

It occasionally grows very high. Specimens on the campus at Evanston measured 4 feet in height.

SCROPHULARIA, Tourn.

740. *S. nodosa*, L., var. *marilandica*, Gray. Fig-wort.

S. nodosa, L., in *Manual*, 5th Ed.

Damp grounds, banks of streams, borders of woods, fence-rows, etc.; common. June—August.

Specimens have been noted in several localities that were over 5 feet in height.

COLLINSIA, Nutt.

741. *C. verna*, Nutt. Collinsia. Innocence.

Swamps or low prairies; frequent. June.

Calumet Region. Wilmette, *Miss Belle Alling*. Riverside, *Babcock*.

River Park and Maywood, *Bastin*. Blue Island, *Dodge*.

Flowers occasionally of uniform color, either blue or white.

CHELONE, Tourn.

742. *C. glabra*, L. Turtle-head.

Damp or wet places; frequent. July—September.

Often over 4 feet in height. The leaves are rarely doubly serrate.

PENSTEMON, Mitch. Beard-tongue.

743. *P. pubescens*, Solander.

Dry ground; infrequent. June—August.

Sometimes entirely glabrous. Flowers usually somewhat variegated or uneven in color.

744. *P. lævigatus*, Solander, var. *digitalis*, Gray.

P. digitalis, Nutt.

Moist rich soil; frequent. July—August.

Glencoe. Evanston. Bowmansville. Riverside. Calumet Region.

Englewood, *Bastin*. Forest Hill, *Dodge*! Normal Park, *Brennan*.

The type may be found within our limits.

MIMULUS, L. Monkey-flower.745. **M. ringens, L.**

Swamps, ditches and wet banks; common. July—August.

746. **M. jamesii, Torr.**

Near Miller's, Ind. Found only in July, 1885. This locality has not been visited since, at the proper season.

It will probably be found in other localities. (B.)

GRATIOLA, L.747. **G. virginiana, L.** Hedge-Hyssop.

Wet prairies and banks; frequent or common. June 20th—July.

748. **G. SPHEROCARPA, Ell.** Hedge-Hyssop.

Evanston, *Boltwood!* (B.)

ILYSANTHES, Raf.749. **I. riparia, Raf.** False Pimpernel.

I. gratioloides, Benth.

Wet places; infrequent. July—August.

Chiefly in the Calumet Region. Near Miller's, Ind.; rare, *Babcock!*

VERONICA, L.750. **V. virginica, L.** Culver's Physic.

Rich woods, moist banks and prairies; frequent. July—August.

751. **V. anagallis, L.** Water Speedwell.

Borders of streams and lakes, ditches and wet prairies; southward, frequent, elsewhere infrequent. July.

Flowers occasionally entirely blue.

752. **V. americana, Schwein.** American Brooklime or Speedwell.

Brooks and ditches and borders of lakes and sloughs; frequent. June—August. (B.)

753. **V. scutellata, L.** Marsh Speedwell.

Niles woods; rare. June—July.

Swamps near Lake Calumet; frequent. *Stony Island, Hill!* River-side; rare, *Babcock.*

754. **V. serpyllifolia, L.** Speedwell.

Roadsides and dry fields; common. May—August. (B.)

Spreads rapidly.

755. **V. peregrina, L.** Neck-weed. Purslane Speedwell.

Cultivated and waste grounds, roadsides, etc.; common. May—June.

756. *V. arvensis*, L. Corn Speedwell.

Cultivated grounds near Austin; infrequent. May—June.
Glencoe and Winnetka; common, *Babcock*.

BUCHNERA, L.

757. *B. americana*, L. Blue-Hearts.

Moist sandy soil, in pine barrens southward; usually not common.
July—September.

Miller's, Ind.; frequent. Pine Station, Ind., *Babcock*/ Edgemoor,
Ind.; frequent, *Johnson*/ Normal Park, *Brennan*.

SEYMARIA, Ph.

758. *S. macrophylla*, Nutt. Mullein-Foxglove.

Banks of the Desplaines river, near Riverside, July, *Babcock*!

GERARDIA, L. Gerardia.

759. *G. pedicularia*, L. Lousewort. Foxglove.

Dry open woods and copses; infrequent. August.

760. *G. flava*, L. Downy False Foxglove.

Open woods and shrubby fields; infrequent or rare. August—
September. (B.)

Niles woods. Riverside. Lamont. Normal Park, *Brennan*.

761. *G. quercifolia*, Ph. Smooth False Foxglove.

Rich woods and banks; frequent. July—August.

762. *G. LEVIGATA*, Raf.

G. integrifolia, Gray.

South Chicago, *University of Chicago Herb.* (B.)

763. *G. auriculata*, Michx.

South of Hyde Park Station; rare, *Babcock*. Exterminated at this
point, but found further south. South Chicago and southward;
infrequent or rare, August.

The white-flowered form is occasionally seen.

764. *G. purpurea*, L. Purple Gerardia.

Low grounds; common in the eastern portion of our district.
August.

765. *G. purpurea*, L., var. *paupercula*, Gray.

In similar localities with the type; rare. July—August. (B. P.)
Near Berry Lake, Ind., 1884. Forsyth, Ind., *Hill*.

766. *G. tenuifolia*, Vahl. Slender Gerardia.

Rich woods and banks, north and east; not common. August—
September.

767. *G. skinneriana*, Wood.*G. setacea*, in Manual, 5th Ed.*

Dry soil; frequent or common south. July—August. (B.)
Evanston and northward; rare.

CASTELLEIA, Mutis.768. *C. coccinea*, Spreng. Scarlet Painted-cup. Indian Pink.

Prairies and low grounds in sandy soil; common, often abundant.
May—July.

The yellow-flowered form is quite frequent, seemingly in drier soil.
Rogers Park. South Chicago. Hyde Park. Miller's, Ind., Hill!

PEDICULARIS, Tourn.769. *P. canadensis*, L. Common Lousewort. Wood Betony.

Open woods, banks, etc.; common. May—June.
Purplish flowers are quite frequent.

770. *P. lanceolata*, Michx. Lousewort.

Wet open woods and swamps; frequent south, infrequent elsewhere.
August—September, occasionally as late as October.

MELAMPYRUM, Tourn.771. *M. americanum*, Michx. Cow-Wheat.

Glencoe; rare, *Babcock*. Maywood and Riverside, S. R. Copeland.
Pine Station, Ind., *Bastin*! Gibson's and Miller's, Ind.; infrequent. (P.)

OROBANCHACEÆ.**CONOPHOLIS**, Wall.772. *C. americana*, Wall. Cancer-root. Squaw-root.

In open oak woods; rare. June—July. (B.)
Lakeside. Woodlawn. Maywood. Desplaines. Stony Island, Hill.

APHYLLON, Mitchell.773. *A. uniflorum*, Gray. One-flowered Cancer-root.

Damp woods; rare. May.
Wilmette. Maywood. Kensington. Glencoe and Riverside, *Babcock*! Evanston, near the lake shore, *Johnson*. Normal Park, *Brennan*, *Williams*. Berry Lake, Ind., Hill! Lamont, Hill.

774. *A. fasciculatum*, Gray. Cancer-root.

In sandy soil. May.
Glencoe and woods near Stony Island; rare, 1885-'87. Sand hills north of Pine Station, Ind.; rare, *Babcock*! Sands by the lake shore, Pine Station, Ind.; a parasite on *Antennaria*, Hill! Edgemoor, Ind.; a parasite on *Artemisia biennis*, Willd., *Boltwood*, *Johnson*.

**G. setacea*, Walt., is a more southern form.

LENTIBULACEÆ.**UTRICULARIA**, L. Bladderwort.775. **U. vulgaris**, L. Common or Greater Bladderwort.

In stagnant pools, and in streams where the current is in the center, and moves slowly at the banks; from South Chicago, southward, common; infrequent elsewhere. May 25th—August.

Sometimes found without bladders.

776. **U. minor**, L. Smaller Bladderwort.

Shallow water, near South Chicago, and probably with the last; apparently rare. July. (B.)

777. **U. gibba**, L.

Shallow water near the southern end of Lake Calumet, July, 1885.

Bogs at Miller's, Ind.; rare, *Babcock*! Margins of pools, Pine Station, Ind., *Hill*, *Brennan*!

778. **U. purpurea**, Walt.

Ponds; Pine Station, Ind., *Hill*! Miller's, Ind. (B. P.)

779. **U. resupinata**, B. D. Greene.

Near Whiting, Ind., in but one locality, August—September, *Hill*.
Casella, Ind., *Hill*! (B. P.)

780. **U. cornuta**, Michx.

Wet places; chiefly southward; frequent. July. (P.)

NOTE.—*U. intermedia*, Hayne, may be found within our limits.

BIGNONIACEÆ.**TECOMA**, Juss.781. **T. RADICANS**, Juss. Trumpet-creeper. Trumpet-flower.

Commonly cultivated. Escaped cultivation at Evanston. Seemingly established at Riverside and in the camping grounds at Desplaines. Near Riverside two specimens were found remote from cultivated grounds, growing in the rich soil on the banks of the river. July—August. (B.)

CATALPA, Scop., Walt.782. **C. BIGNONIODES**, Walt. Catalpa. Indian Bean.

Though not indigenous, it is frequently found in cultivated grounds, and has become well established and acclimated. July. (B.)

ACANTHACEÆ.**RUELLIA**, Plumier.783. **R. ciliosa**, Ph. Ruellia.

Rather dry but rich soil; infrequent or rare. June—August.

West of Garfield Park, 1882. Hawthorn. Near Brighton. Banks of M. C. R. R., east of Calumet, and north of Riverside; rare, *Babcock*. Riverdale, *Bastin*.

VERBENACEÆ.

VERBENA, Tourn.

784. *V. urticæfolia*, L. White Vervain. Nettle-leaved Vervain.

Fields, roadsides, banks and open woods; infrequent and mainly south. July—August.

Hybrid forms are not infrequent.

(a) Form with flowers sometimes pale-blue; rare, near Riverside.

(b) Form with pinkish flowers; rare. Hyde Park. Maywood.

785. *V. angustifolia*, Michx. Narrow-leaved Vervain.

Dry soil, chiefly north; infrequent. July.

786. *V. hastata*, L. Blue Vervain.

Prairies, banks, roadsides, etc.; abundant. June—September.

In some seasons, the form with the leaves free from lobes, is common.

787. *V. stricta*, Vent. Hoary Vervain.

Barren fields, prairies and banks; frequent or common. July.

788. *V. bracteosa*, Michx. Prostrate Vervain.

Prairies and waste grounds; frequent. July—September.

LIPPIA, Houst.

789. *L. lanceolata*, Michx. Fog-fruit.

Banks of the Desplaines river; common. Wet places southward; frequent. July—August.

PHRYMA, L.

790. *P. leptostachya*, L. Lop-seed.

Woods and moist shaded banks, especially southward; common. July.

Palatine and Riverside; common, *Babcock*.

LABIATÆ.

ISANTHUS, Michx.

791. *I. cæruleus*, Michx. False Pennyroyal.

Bluffs near the lake shore at Evanston; frequent.

Gravelly and sandy banks, Englewood, *Hill*. July—Sept. (B.)

TEUCRIUM, L.

792. *T. canadense*, L. American Germander. Wood Sage.

Banks of streams and low grounds; frequent. July—August.

The white variety at Riverside and Harlem, *Babcock*.

COLLINSONIA, L.

793. *C. canadensis*, L. Stone-root. Collinsonia.

Rich woods; infrequent or rare. July—August. (B.)

Glencoe. Niles. Maywood.

MENTHA, Tourn. Mint.794. *M. viridis*, L. Spearmint.

Wet grounds; not common. July. (B.)

795. *M. piperita*, L. Peppermint.

Moist banks; infrequent or rare. (B.)

Maywood. Desplaines. Lamont.

796. *M. canadensis*, L. Wild Mint. Horse-Mint.

Moist or low grounds; common or abundant. June—September.

LYCOPUS, Tourn.797. *L. virginicus*, L. Bugle-weed

Shaded and moist banks, and in swampy places; frequent. July—August. (B.)

798. *L. sinuatus*,* Ell. Water-Horehound.*L. europæus*, L., var. *sinuatus*, Gray.

Wet places; common.

PYCNANTHEMUM, Michx. Mountain Mint. Basil.799. *P. lanceolatum*, Ph.

Usually in dry or slightly moist prairies and open woods; common. August—September.

800. *P. linifolium*, Ph.

Dry open woods, fields and fence-rows; frequent. August. (B.)

801. *P. muticum*, Pers., var. *pilosum*, Gray. Basil.*P. pilosum*, Nutt.

On a dry bank near Palatine; rare, August, 1885

Riverside, 1878, Bastin. (B.)

CALAMINTHA, Tourn.802. *C. nuttallii*, Gray. Calaminth.*C. glabella*, Benth., var. *nuttallii*, Gray.

Dry grounds, mainly in the eastern part of our district; infrequent. June—July.

HEDROMA, Pers.803. *H. pulegioides*, Pers. American Pennyroyal.

Dry open woods and fields; common. June—September.

Corolla usually about 3, occasionally 4 lines long.

A decidedly pubescent form has been collected near Glencoe.

*Babcock, in his list of plants of Chicago and vicinity, (Lens, vol. 1., p. 146), enumerates *L. europæus*, L.; not common, Calumet.

The writers have not been able to find the typical *europæus*. *L. sinuatus* is common at this point.

MONARDA, L.

- 804.
- M. DIDYMA*
- , L. Oswego Tea.

Rare.

Riverside.

A few specimens with the flowers bright scarlet and over $2\frac{1}{2}$ inches long were collected near South Chicago. Pine Station, Indiana, Brennan. (B. P.)

- 805.
- M. fistulosa*
- , L. Wild Bergamot. Horse-Mint.

Rather dry banks, open woods and fence-rows; common, locally abundant. July—September, occasionally in November.

- 806.
- M. BRADBURIANA*
- , Beck. Monarda.

South of Hyde Park; local, Babcock.

- 807.
- M. punctata*
- , L. Horse-Mint.

Sandy fields, open woods and banks; common southward, less common elsewhere. July—September.

BLEPHILIA, Raf. Blephilia.

- 808.
- B. ciliata*
- , Raf.

Dry ground, old fields, roadsides, etc.; infrequent. June—September. (B.)

- 809.
- B. hirsuta*
- , Benth.

Rich woods, north; infrequent. July.

Palatine; rare, Babcock.

LOPHANTHUS, Benth. Giant Hyssop.

- 810.
- L. nepetoides*
- , Benth.

Open woods and copses; frequent. July—August.

- 811.
- L. scrophulariæfolius*
- , Benth.

Glencoe and Calumet Region; frequent, locally. Banks of the Desplaines river; rather scarce. Riverside, Bastin. Harlem; rare, Babcock.

NEPETA, L.

- 812.
- N. CATARIA*
- , L. Catnip.

Waste places and woods; frequent, locally. July—September.

- 813.
- N. GLECHOMA*
- , Benth. Ground Ivy. Gill.

Damp grounds near dwellings, and rarely in woods; infrequent. May—July.

Common at Evanston and northward. In woods near Maywood.

DRACOCOEPHALUM, Tourn.

- 814.
- D. PARVIFLORUM*
- , Nutt. Dragon-head.

Maywood; rare, Babcock. (P.)

SCUTELLARIA, L. Scullcap.815. *S. lateriflora*, L. Mad-dog Skulcap.

In damp shaded places; common. July—September.

816. *S. parvula*, Michx.

Sandy soil or moist woods and copses, Lake County, Ind.; infrequent or rare. May—July.

817. *S. galericulata*, L.

Moist shaded banks of streams, borders of woods, and frequently in wet fields; frequent or common. July—August.

BRUNELLA, Tourn.818. *B. vulgaris*, L. Self-heal. Heal-all.

Dry places; common, often abundant. July—August.

White form at Glencoe, *Babcock*.**PHYSOSTEGIA, Benth.**819. *P. virginiana*, Benth. False Dragon-head.

Wet banks; common southward, less frequent elsewhere. July—August.

MARRUBIUM, Tourn.820. *M. vulgare*, L. Horehound.

Escaped from cultivation at Evanston, and in a few other places.

Not well established. July—September. (B.)

LEONURUS, L.821. *L. cardiaca*, L. Common Motherwort.Waste places, more frequently around dwellings and barnyards
July—August.**GALEOPSIS, L.**822. *G. tetrahit*, L. Common Hemp-nettle.

Waste places; infrequent. August. (B. P.)

STACHYS, Tourn.823. *S. palustris*, L. Hedge-nettle. Woundwort.

Banks of streams and wet places; frequent. June—September.

824. *S. aspera*, Michx. Hedge-nettle.*S. palustris*, L., var. *aspera*, Gray.

Banks and wet places; infrequent. July—August. (B.)

PLANTAGINACEÆ.**PLANTAGO, Tourn.**825. *P. cordata*, Lam. Heart-leaved Plantain.Wet places, banks of streams and lakes; infrequent. May—July.
Lakeside. Glencoe. Niles woods.

Individuals of this species are usually scattered, not more than one or two being found in a locality.

826. *P. major*, L. Common Plantain. Ribwort. Wayside Plantain. Roadsides, around dwellings, waste places, etc.; common or abundant. May 20th—September. Spikes are occasionally 20 inches long.

827. *P. rugellii*, Decaisne. Plantain.

P. kamtschatica, in Manual, 5th Ed.

A few specimens were found in 1887 on banks of C. & N. W. R. R., near Palatine. July. (B. P.)

This species closely resembles *P. major*, L., and probably has been overlooked.*

828. *P. lanceolata*, L. Ribgrass. English Plantain. Ripplegrass. Ribwort.

In dry fields throughout our district; rare. June—July. (B.)

Possibly indigenous. Leaves from a foot to two feet in length, rarely three.

829. *P. virginica*, L. Ribgrass.

Evanston. Desplaines. Palatine. Pullman. Glencoe, *Herman Jaeger*. Englewood, *Brennan*. Grand Crossing, April, 1887, *Bastin*. (B.)

NYCTAGINACEÆ.

OXYBAPHUS, Vahl.

880. *O. nyctagineus*, Sweet. *Oxybaphus*.

A few specimens were found in July, 1885, at a quarry near Cheltenham Beach. Though looked for, they have not been found since, and were probably exterminated by the removal of the soil from the rocks, previous to blasting.

During the season of 1887, a few specimens were obtained from Stony Island. In both cases, the plants grew near an out-crop of limestone. (B.)

*Since the note concerning *P. rugellii* was written, and during the season of 1890, the writers made a more careful study of *P. major* in this section, and are inclined to believe that the former species may be quite common. Lack of time prevented a sufficiently exhaustive study to settle the point.

For the help of students and collectors, we quote the following from the *Cayuga Flora*, p. 74: *P. major*, L., is distinguished from *P. rugellii*, Decaisne, by its thicker, shorter spike, its short ovoid-obtuse capsules, and ovate, obtuse, scarious margined sepals, and its leaves often dull green and hairy. In the latter species the spikes are longer, less dense, capsules oblong cylindrical, and sepals oblong and acute. The leaves are large, usually shining, bright green, the petioles often tinged with purple.

ILLECEBRACEÆ.

ANYCHIA, Michx. Forked Chickweed.

881. **A. dichotoma**, Michx.

Woods and shaded places; not common. June—July. (B.)

882. **A. capillacea**, D C.

A. dichotoma, Michx., var. *capillacea*, Torr.

Chicago, July 25th, 1877,—*University of Chicago Herb.* Near River-side. (B. P.)

Grows in drier soil than the foregoing species.

AMARANTACEÆ.

AMARANTUS, Tourn.

883. **A. RETROFLEXUS**, L. Pig-weed. Red-root. Amaranth.

Old gardens and cultivated fields; common. July—September.

884. **A. albus**, L. White Pig-weed. Tumble-weed*.

Sandy soil near the lake shore, southward; infrequent Western portion of our district more common.

A form with reddish stems and calyx; leaves small and prominently mucronate, is reported from Englewood by Prof. Hill.

885. **A. SPINOSUS**, L. Thorny Amaranth.

Euxolus spinosus, Feay.

Introduced sparingly near Union Stock-yards, *Babcock*. Prairies near the corner of Halsted and 55th Sts., along the railroad, 1884.

ACNIDA, Mitch.

886. **A. tuberculata**, Moq. Water-hemp.

Montelia tamariscina, Gray, in part.

Along the lake shore; rare. August—September.

Desplaines river, *Babcock*.

CHENOPODIACEÆ.

CYCLOLOMA, Moq.

887. **C. platyphyllum**, Moq. Winged Pig-weed.

Near Grand Crossing on banks of I. C. R. R. and North Chicago; rare, *Babcock*. Sandy borders of C. R. I. & P. R. R., Normal Hill! South Evanston, *Johnson*.

*The name tumble-weed is more applicable to the plant when growing on the plains. It has its origin in the following habit, which may be witnessed, to some extent, within our limits: "It grows in a globular form, often 3 to 4 feet in diameter. When killed by frost, the branches remain rigid, the plant soon loosens from the soil, and the wind drives it bounding over the fields and prairies, until brought up in some fence corner. * * * This is an effective method of scattering the seed."—*J. C. Arthur*.

CHENOPODIUM, Tourn. Goose-foot. Pig-weed.888. **C. ALBUM**, L. Lamb's-Quarters.

Cultivated grounds, roadsides, old fields, etc.; common or abundant.
July—September.

This is a very variable species, but is rather polymorphous, than including distinct varieties.

889. **C. URBIUM**, L.

In waste places; infrequent.

840. **C. hybridum**, L. Maple-leaved Goose-foot.

Waste grounds everywhere; common. July—August, occasionally as early as June.

- Quite variable as to size and shape of the leaves, and height of plants—2 to 5 feet high.

841. **C. GLAUCUM**, L. Oak-leaved Goose-foot.

In streets and waste places; frequent.

Brackish borders of Lake Calumet, 1886-'87.

842. **C. BOTRYS**, L. Jerusalem Oak. Feather Geranium.

Occasionally found along the lake shore from South Chicago, southward. June 25th—September.

848. **C. AMBROSIOIDES**, L. Mexican Tea.

Roadsides, waste places, etc.; common. July—August. (B.)

ATRIPLEX, Tourn.844. **A. patulum**, L. Orache.

Summerdale, *Johnson*. Chicago, *Babcock*.

845. **A. patulum**, L., var. **hastatum**, Gray.

Along Archer Ave.; local, *Babcock*.

In this locality it seems to have been exterminated. The banks of the Chicago river in the Bridgeport and Brighton districts, where there is no dockage, furnishes the proper soil. Near Brighton, 1880, *S. R. Copeland*. Stock-yards, *University of Chicago Herb.*, credited to *Babcock*. Englewood, *Hill*. Along the canal, a short distance east of Summit, 1888, *C. P. Murray*.

These reports would indicate that this species is indigenous to the district, from Bridgeport, southwest; a territory subject to constant changes. This may account for its rarity and apparent extermination.

CORISPERMUM, Ant. Juss.846. **C. hyssopifolium**, L. Bug-seed.

Along the lake shore; frequent. Lake Calumet, east shore; rare.
Sand of the lake shore; abundant, 1870, *Babcock*. September.

SALSOLA, L.**847. S. KALI, L. Common Saltwort.**

Frequent on the lake shore near the University grounds, Evanston, where it is associated with *Lathyrus maritimus*, Bigel., and *Polanasia graveolens*, Raf.

This is the only locality within our limits from which the plant has been reported. (B.)

PHYTOLACCACEÆ.**PHYTOLACCA, Tourn.****848. P. decandra, L. Poke-root. Pigeon-berry.**

Moist grounds, chiefly southward; infrequent. August.

Niles. Evanston, *Boltwood*! Englewood, *Hill*! Union Stockyards and Harlem; rare, *Babcock*.

In the Calumet Region, specimens occasionally attain a height of 12 feet.

POLYGONACEÆ.**RUMEX, L.****849. R. britannica, L. Great Water-Dock.**

R. orbiculatus, Gray.

Wet places, near ponds, ditches and lakes southward; infrequent. August.

Glencoe, *Johnson*. Thatchers; not common, *Babcock*.

850. R. altissimus, Wood. Peach or Pale-leaved Dock.

R. britannica, in Manual, 5th Ed.

Probably rare. June—July. (B.)

Near Lake Hyde, 1884. Swamps near north end of Lake Calumet, 1888-'86. Calumet Region, *S. R. Copeland*. Glencoe, *Johnson*.

851. R. verticillatus, L. Swamp Dock.

Swamps; apparently infrequent. July. (B.)

Hawthorn. Near Blue Island. Glencoe, *S. R. Copeland*.

852. R. crispus, L. Curled Dock. Yellow Dock.

Cultivated and waste grounds, usually in dry soil; abundant. June—October. (B.)

853. R. obtusifolius, L. Bitter Dock.

With the last; common. June—July. (B.)

A form which is apparently a hybrid of this species and *R. crispus*, L., is occasionally found.

854. R. sanguineus, L. Bloody-veined Dock.

Waste places, near cultivated grounds; throughout, but infrequent or rare. July. (B. P.)

855. *R. acetocella*, L. Field or Sheep Sorrel.
In waste places, old fields, etc.; very abundant. June—September,
occasionally as early as May 15th.

POLYGONUM, Tourn. Knotweed. Polygonum.

856. *P. aviculare*, L. Knot-grass. Door-weed. Goose-grass.
Near buildings, and everywhere in waste places. July—September.

857. *P. erectum*, L. Erect Knot-grass.

P. aviculare, L., var. *erectum*, Roth.

Rich and moist soil in shaded places; frequent. July—August.

858. *P. ramosissimum*, Michx.

Lake shore at Evanston; rare. July, 1884-'87. Near Lake Calumet.
Sandy shore near South Chicago, *Bastin*/ (B.)

859. *P. tenue*, Michx.

Rare. September. (B.)

Hyde Park, *Bastin*. Sand hills, near Whiting, Ind., *Hill*/

860. *P. lapathifolium*, L., var. *incarnatum*, Watson.

P. incarnatum, Ell.

Marshes and borders of lakes and ponds; common. July—August.
During the season of 1886, the white-flowered form prevailed, and
was common at Lake Hyde, Ind.

The flowers were mostly flesh-colored during 1887.

861. *P. pennsylvanicum*, L.

Moist banks and ditches, roadsides and moist places; frequent south
and west. July—September.

862. *P. amphibium*, L. Water Persicaria.

Generally in the form of Var. *aquaticum*, Willd.

Chiefly in shallow water south; infrequent elsewhere. July—August.

863. *P. muhlenbergii*, Watson.

P. amphibium, L., var. *terrestre*, Gray.

Muddy banks of the Desplaines river, near Riverside. On the prairies
southeast of the Bridewell; infrequent. Miller's and Berry Lake,
Ind. Evanston, *Boltwood*. Sandy borders of sloughs, Pine
Station, Ind., *Hill*. (B. P.)

864. *P. orientale*, L. Prince's Feather.

Sparingly escaped from cultivation. Spontaneous in gardens.
August.

865. *P. persicaria*, L. Lady's Thumb. Heart-weed.

Moist waste places; common, locally abundant. June—September.

866. *P. hydropiperoides*, Michx. Mild Water-pepper.
Aquatic, or in muddy places; frequent southward and north to
Riverside, elsewhere infrequent. July 25th—September.
867. *P. hydropiper*, L. Common Smartweed. Water-pepper.
Moist or swampy places; frequent and scattered. July 20th—
October.
868. *P. acre*, H. B. K. Water Smartweed.
Swamps, ditches and borders of lakes and rivers; frequent south-
ward. July—September. (B.)
869. *P. virginianum*, L.
Shaded rich woods; common. August.
870. *P. sagittatum*, L. Arrow-leaved Tear-thumb.
Damp or wet places, Lake County, Ind.; frequent, elsewhere less
common. August.
A form is occasionally found with the stem rounded, and with the
reflexed prickles scattered.
871. *P. convolvulus*, L. Black Bindweed. Knot Bindweed.
Fields and waste grounds; frequent from Riverside, south through
the Calumet Region, and to the lake shore; infrequent elsewhere.
June—September, usually in July.
872. *P. dumetorum*, L., var. *scandens*, Gray. Climbing False-
Buckwheat. Hedge Bindweed.
Moist woods and shaded banks; frequent. August—September.

FAGOPYRUM, Tourn.

873. *F. esculentum*, Moench. Buckwheat.
Old fields, escaped from cultivation; infrequent. June—August. (B.)

POLYGONELLA, Michx.

874. *P. articulata*, Meisner. Joint-weed.
Polygonum articulatum, Gray.
Bluffs near Evanston; rare. Miller's, Ind., Bastin/ Sand hills,
Tolleston, Ind., Hill.
White-flowered form, Miller's, Ind., Hill!

PODOSTEMACEÆ.

PODOSTEMON, Michx.

875. *P. ceratophyllus*, Michx. River-weed. Thread-foot.
South Chicago, University of Chicago Herb. (B. P.)

ARISTOLOCHIACEÆ.**ASARUM**, Tourn.

876. **A. canadense**, L. Wild Ginger. Canada Snakeroot.

Rich moist woods; infrequent, probably local, more common north and northwest. May—June.

Glencoe. Niles. Near Riverside. Palatine. Near Washington Heights; frequent. Rose Hill, *Johnson*! Forest Hill, *Brennan*.

PIPERACEÆ.**SAURURUS**, L.

877. **S. cernuus**, L. Lizard's Tail.

Swamps, south and southeast.

Glencoe and Evanston; rare. July. (B.)

LAURACEÆ.**SASSAFRAS**, Nees.

878. **S. officinale**, Nees. Sassafras.

Rich and rather open woods; scattered. May.

Winnetka. Palatine. Riverside; rare. South Chicago. Sheffield, Pine Station and Miller's, Ind.

LINDERA, Thunb.

879. **L. benzoin**, Blume. Spice-bush. Benjamin-bush. Allspice.

Moist woods; rare. April—May. (B.)

Niles. Riverside. Casella, Ind. Bank of the Calumet river, near Miller's, Ind. Highland Park, Lake County, Ills., *C. P. Murry*.

ELÆAGNACEÆ.**SHEPHERDIA**, Nutt.

880. **S. canadensis**, Nutt. Canadian Shepherdia.

Bluffs. May 12th—July.

Glencoe and Evanston; frequent. Borders of sloughs and sandy banks; Pine Station, Ind.; common, *Babcock*, *Hill*!

SANTALACEÆ.**COMANDRA**, Nutt.

881. **C. umbellata**, Nutt. Bastard Toad-flax.

Dry banks and fields in sandy soil; common, chiefly eastward. May 25th—June.

Riverside, *Babcock*.

EUPHORBIACEÆ.

EUPHORBIA, L. Spurge.

882. **E. polygonifolia**, L. Shore Spurge. Knotgrass Spurge.

Sandy soil of the lake shore, both north and south; frequent. July—September.

Near Lake Calumet; rare.

883. **E. maculata**, L. Spotted Spurge.

Roadsides, old gardens, etc.; common, often abundant. September.

884. **E. preslii**, Guss.

E. hypericifolia, in Manual, 5th Ed.

Open woods and fields, chiefly in sandy soil, near the lake shore from Glencoe south to Pine Station, Ind. Riverside and Calumet; probably rare. From Evanston to Palatine; frequent. July—October.

885. **E. corollata**, L. Flowering Spurge. White Spurge.

In dry soil; everywhere common, often abundant. June—September, occasionally as late as November.

A form that is densely and softly pubescent, at least below, occurs on sand hills near Pine Station, Ind., *Hill*.

886. **E. cyparissias**, L. Garden Spurge. Cypress Spurge.

Roadsides and near gardens; frequent. June—July. (B.)

887. **E. commutata**, Engelm.

Local. May—July.

Maywood. Calumet. Riverside, *Babcock*!

ACALYPHA, L.

888. **A. virginica**, L. Three-seeded Mercury.

Fields and open woods; frequent. July—October. (B.)

URTICACEÆ.

ULMUS, L.

889. **U. fulva**, Michx. Slippery or Red Elm.

In rich woods; frequent locally. April 15th—May 10th. (B.)

North Evanston. Niles. Riverside and Maywood, on the banks of the Desplaines river.

890. **U. americana**, L. White Elm. American Elm. Water Elm.

Moist woods, along streams, throughout our district; infrequent and scattered. April—May 10th.

Cultivated for ornament.

NOTE.—*Ulmus alata*, Michx., Whahoo or Winged Elm.

Two or three specimens have been introduced, and are under cultivation at Evanston.

CHELTIS, Tourn.

- 891.
- C. occidentalis*
- , L. Sugarberry. Hackberry.

Rich woods; rare. April—May.

Winnetka. Banks of the Calumet, near Miller's, Ind. Desplaines river, north of Thatcher; rare, *Babcock*.**CANNABIS**, Tourn.

- 892.
- C. SATIVA*
- , L. Hemp. Red-root. Neckweed.

Waste places; frequent. July—August.

HUMULUS, L.

- 893.
- H. lupulus*
- , L. Common Hop.

Riverside, on the banks of the Desplaines river, and Salt Creek; not common, *Babcock*! July.**MORUS**, Tourn.

- 894.
- M. rubra*
- , L. Red Mulberry.

Riverside, east of river and north of R. R.; not common, *Babcock*! Near River Park, 1879, *Bastin*. June.**URTICA**, Todrn.

- 895.
- U. gracilis*
- , Ait. Tall Nettle.

Moist grounds, bordering woods, fields, waste places, etc.; locally common. June 20th—August.

- 896.
- U. dioica*
- , L. Stinging Nettle.

Waste places; scattered and rare. August. (B.)

LAPORTEA, Gaud.

- 897.
- L. canadensis*
- , Gaud. Wood Nettle.

Moist rich woods; not common. July—September.

Niles woods; common. (B.)

PILEA, Lindl.

- 898.
- P. pumila*
- , Gray. Richweed. Clearweed.

Moist shaded banks and rich woods. June 15th—September.

Niles woods; common. Riverside and Calumet Region; infrequent, elsewhere rare.

BOEHMERIA, Jacq.

- 899.
- B. cylindrica*
- , Willd. False Nettle.

Swamps and shaded moist banks and woods, south and southeast; frequent, elsewhere infrequent. June—August.

PARIETARIA, Tourn.

- 900.
- P. pennsylvanica*
- , Muhl. Pellitory.

Near the lake shore, northward; infrequent or rare. June—July. (B.)

JUGLANDACEÆ.

JUGLANS, L.

- 901.
- J. cinerea*
- , L. Batternut. Oil-nut.

Wilmette. Niles. Woods north of Riverside, Babcock! Rare and local. May.

- 902.
- J. nigra*
- , L. Black Walnut.

Rich woods northward; infrequent. May—June 10th.

HICORIA, Raf. (*Carya*, Nutt.)

- 903.
- H. ovata*
- , Britt. Shell or Shag-bark Hickory.

Carya alba, Nutt.

Woods and fields, mainly in the northern and western portions of Cook County; frequent. May. (B.)

- 904.
- H. glabra*
- , Britt. Pig-nut. Broom Hickory.

Carya porcina, Nutt.

Winnetka, north and west; frequent. May. (B.)

- 905.
- H. minima*
- , Britt. Bitter-nut. Swamp Hickory.

Carya amara, Nutt.

Moist or swampy open woods; infrequent. May. (B.)

Evanston and northward in ravines: Niles woods.

MYRICACEÆ.

MYRICA, L.

- 906.
- M. CERIFERA*
- , L. Wax-Myrtle.

A single specimen of this shrub, on the lake shore near Cheltenham Beach, was noted in 1884-'85. In 1886 it had disappeared, probably destroyed by workmen. It was, so far as known, the only representative of the species within our limits.

This species is seldom found as far west as Ohio. In Michigan, two specimens have been reported from the shore of Lake Erie. (B. P.)

- 907.
- M. asplenifolia*
- , Endl. Sweet Fern.

Comptonia asplenifolia, Ait.

Common in the sandy soil of the southeastern portion of our district; less frequent northward. April—May.

CUPULIFERÆ.

BETULA, Tourn.

- 908.
- B. populifolia*
- , Ait. American White Birch.

B. alba, var. *populifolia*, Spath.

Near the lake shore, both north and south; rare.

Glencoe and Pine Station, Ind., Babcock! (P.)

909. *B. papyrifera*, Marsh. Paper or Canoe Birch.

B. papyracea, Ait.

Rich and moist woods and banks; frequent, especially near the sandy sloughs southeast. (B.)

Prof. Hill reports the following forms from Pine Station, Ind.:

(a.) Leaves abrupt or wedge-shaped at the base, short pointed.

(b.) Leaves heart-shaped at the base, somewhat pointed.

(c.) Leaves abrupt or rounded at the base, long pointed.

The trees were small, 10 to 20 feet high; bark white, except in the youngest trees; leaves on the young shoots large and hairy.

910. *B. pumila*, L. Low Birch. Tag Alder.

Two specimens were found in a slough near Lake George and East Chicago. Sloughs at Miller's, Ind.; common, *Babcock!* Rose Hill, *Johnson*.

ALNUS, Tourn.

911. *A. incana*, Willd. Speckled, Black or Hoary Alder.

Banks of streams and sloughs; infrequent. April—May.

Banks of Desplaines river, near Riverside. (B. P.)

912. *A. serrulata*, Willd. Smooth Alder.

Edgemoor, Ind., *Boltwood*. (B.)

CORYLUS, Tourn.

918. *C. americana*, Walt. Common Wild Hazel-nut.

Clearings and woods; common. April.

OSTRYA, Michx.

914. *O. virginica*, Willd. American Hop-Hornbeam. Iron-wood.

Lever-wood. Deer-wood.

Rich woods, throughout our district, especially northward, but far from common.

Usually the trees are much scattered.

CARPINUS, L.

915. *C. caroliniana*, Walt. American Hornbeam. Blue or Water Beech. Iron-wood.

C. americana, Michx.

Ravines of the north; rare. May.

Calumet river, near Miller's, Ind. Banks of the Desplaines river, *Babcock!*

QUERCUS, L. Oak.

916. *Q. alba*, L. White Oak.

Rich soil; common. May 20th—June 15th.

917. *Q. stellata*, Wang. Post, Rough or Box White Oak. Iron Oak. Turkey Oak.

Q. obtusiloba, Michx.

Chiefly in sandy soil, south; rare. May. (B.)

Evanston. Windsor Park. Whiting, Ind.

A single tree in each of these localities.

918. *Q. macrocarpa*, Michx. Bur-Oak. Over-Cup or Mossy-Cup Oak. "White Oak."

Rich soil; frequent. May 15th—June 10th.

919. *Q. bicolor*, Willd. Swamp White Oak.

Rich wet woods and banks of streams; rare and scattered. May 20th—June 5th. (B.)

920. *Q. rubra*, L. Red Oak. Champion Oak.

Usually in rich soil, occasionally in barren places; common. May 12th—25th.

921. *Q. coccinea*, Wang. Scarlet Oak.

Usually in rather dry soil; often in moist places; abundant. May 15th—June.

922. *Q. tinctoria*, Bartram. Black Oak. Quercitron, or Yellow-barked Oak.

Q. coccinea, Wang., var. *tinctoria*, Gray.

Apparently in all kinds of soil; frequent. May 10th—June 5th.

923. *Q. palustris*, Du Roi. Swamp or Spanish Oak. Pin Oak.

Banks of streams and wet places; infrequent. May 10th—25th.

924. *Q. nigra*, L. Black Jack or Barren Oak.

Barren sandy soil; infrequent, north.

925. *Q. imbricaria*, Michx. Laurel or Shingle Oak.

Groves along Flag Creek, about one mile northwest of Willow Springs.

Trees 80 to 60 feet high. On some of the young shoots the leaves are slightly lobed, the mass of the leaves being typical. Fruit ripe in October; rare and local. Hill! (B.)

FAGUS, Tourn.

926. *F. ferruginea*, Ait. American Beech.

A single tree near North Evanston, seemingly indigenous.

Highland Park, Lake County, Ill., W. S. Moffat.

SALICACEÆ.

SALIX, Tourn. Willow.

927. **S. nigra**, Marsh. Black Willow.

Banks of streams and lakes; frequent or common. May. (B.)

928. **S. nigra**, Marsh., var. *falcata*, Torr.

Glencoe, *Babcock!* (P.)

929. **S. amygdaloides**, Ander. Peach-leaved Willow.

S. nigra, Marsh., var. *amygdaloides*, Ander.

South and southeast; frequent. May.

980. **S. lucida**, Muhl. Shining Willow.

Sandy banks of sloughs, and along streams, chiefly southward; frequent. May.

Usually typical.

981. **S. FRAGILIS**, L. Brittle Willow.

I. C. R. R., south of Woodlawn, *Babcock*.

Most likely one of the *fragilis* × *alba* hybrids, *Bebb.* (P.)

982. **S. ALBA**, L., var. *VITELLINA*, Koch.

About dwellings; frequent. May. (P.)

983. **S. longifolia**, Muhl. Long-leaved Willow. Sand-bar Willow.

In wet *sandy* places, from South Chicago southward, not far from the lake shore; frequent. April 15th—August.

Very variable.

984. **S. rostrata**, Rich. Beaked Willow. Livid Willow.

S. livida, Wahl., var. *occidentalis*, Gray.

Moist grounds from Grand Crossing, southeast; common, infrequent or rare elsewhere. April.

In drier places, it has the nature of a tree about 10 feet high. Scales pinkish-tipped; leaves usually serrate.

985. **S. discolor**, Muhl. Glauous Willow. Pussy Willow.

Low places and banks; frequent or common. April.

Two forms occur:

(a) The common form or type.

(b) A low tree form not over 6 feet high, with the serratures reaching to the tip of the leaf; aments, $\frac{3}{4}$ inch long. Whiting, Indiana.

986. *S. humilis*, Marsh. Prairie Willow.

Dry places; common. April.

Dwarf forms are not uncommon, and closely resemble *S. tristis*, but they are not so much branched, the stipules are more evident, and the leaves are long and not crowded.

987. *S. tristis*, Ait. Dwarf Gray Willow.

Bogs and borders of sloughs in dry, sandy soil; infrequent, chiefly from Englewood, southeast. April. (B.)

In sandy soil, Normal Park, 10 to 25 inches high; leaves small or medium, *Hill*.

Seldom over 15 inches in height. A specimen from near Pine Station, Ind., was 28 inches in height; leaves about $1\frac{1}{2}$ inches long, narrow and quite sessile; aments globular; stipules glandular.

988. *S. petiolaris*, Smith. Petioled Willow.

In low sandy soil, chiefly near the lake shore; frequent. April—May 10th.

Prof. Dudley, of Cornell University, has found, without exception, in testing a large number of cases, that the twigs do not disarticulate at the base, while the twigs of *S. sericea*, which it closely resembles in the earlier stages of the development of the staminate plants, are brittle, *Cayuga Flora*, p. 89.

989. *S. petiolaris*, Smith, var. *gracilis*, Ander.

Colehour, Ind.; rare. (B.)

940. *S. candida*, Willd. Sage Willow. Hoary Willow.

Bogs and sloughs of the extreme southeast; frequent. April—May 15. Occasionally 8 feet high.

On a specimen from near Miller's, Ind., the capsules were light pinkish-woolly as were also the young shoots, and the underside of the narrowly-lanceolate leaves.

941. *S. cordata*, Muhl. Heart-leaved Willow.

In wet places; common. April.

Shrubs 8 to 12 feet high.

A form in the collection of C. P. Murray, from Whiting, Ind., has the leaves broadly lanceolate, sharply serrate, retaining the hairiness on the midrib beneath, till very late in the season; stipules ovate, capsules about 2 lines long.

Possibly a hybrid *cordata* × *adenophylla*, *Bebb*.

We have not been able to locate this interesting form, and have only the herbarium specimen to examine. As both *cordata* and *adenophylla* grow near Whiting, a hybrid form is liable to occur and should be looked for.

942. *S. cordata*, Muhl., var. *angustata*, Ander.

With the type; infrequent. (P.)

943. *S. glaucophylla*, Bebb.

Sandy banks of the lake shore, southeast; common, rare northward.
April—May 10th.

944. *S. adenophylla*, Hook.

Sandy soil, near the lake shore, chiefly south of Chicago; frequent.
April 25th—May 20th.

This most interesting willow is essentially an inhabitant of the far north. It is common or abundant locally on the shores of the great lakes.

As it is a plant of stout growth, it is enabled to withstand the strong winds of the lake regions, and rooting deeply, it not only becomes firmly fixed in the soil, but also tends to arrest the influence of the winds that constantly shift the sands of its habitat. It is often found upon the sand dunes, in the southeastern part of our district, facing the lake, and holding the sands in position until a firm growth of grass further protects the loose soil from the ravages of the storms.

945. *S. myrtilloides*, L., var. *pedicellaris*, Ander.

Bogs; rare. May. (B.-P.)

Pine Station and Casella, Ind. Miller's, Ind., Hill!

POPULUS, Tourn.

946. *P. alba*, L. White Poplar. Silver-leaved Poplar. Abele.

Escaped from cultivation and grows spontaneously in a few localities. (P.)

947. *P. tremuloides*, Michx. American Poplar. Aspen.

Woods and open places, following the removal of timber; frequent.
April 5th—25th. (B.)

948. *P. grandidentata*, Michx. Large-toothed Poplar. Aspen.

Woods; not common. April.

Evanston. Niles. Palatine.

949. *P. balsamifera*, L. Balsam Poplar.

In wet places; Evanston and northward; rare. May 1st—15th. (B.P.)

950. *P. monillifera*, Ait. Cottonwood. Necklace Poplar.

Includes *P. angulata*, Ait.

Moist and wet places; frequent or common. April—May.

When planted for shade, the form with red catkins, (male trees), should be selected, if it is desirable to avoid the cotton of the seeds. Often flowers, when not more than 10 feet high.

CERATOPHYLLACEÆ.

CERATOPHYLLUM, L.

951. *C. demersum*, L. Hornwort.

Ditches, ponds, slow streams, etc.; common, occasionally abundant. It is seldom found in fruit, but during August, 1885, fruiting forms were occasionally met with in the Calumet Region and northern Indiana.

HYDROCHARIDACEÆ.

ELODEA, Michx.

952. *E. canadensis*, Michx. Water-weed.

Anacharis canadensis, Planch.

Sluggish streams and ponds; common. July.

VALLISNERIA, L.

953. *V. spiralis*, L. Tape-grass. Eel-grass.

Sluggish streams, southeast; frequent. July 25th—August.

Desplaines river, near Maywood, *Babcock!*

ORCHIDACEÆ.

LIPARIS, Rich. Twayblade.

954. *L. liliifolia*, Rich.

Wet sandy soil, usually in shaded places; rare. June. (B.)

Ravines of the northeast. From South Chicago, southeast. Forest Hill, *Hill*.

955. *L. lœselii*, Rich.

Boggy ground; usually rare. June 15th—July 10th. (B.)

North end of Lake Calumet. Miller's, Ind. South Chicago to Casella, Ind.; quite common, *Hill!* Pine Station, Ind., *Bastin!*

APLECTRUM, Nutt.

956. *A. hyemale*, Nutt. Putty-root.

A clump consisting of a few specimens was found in the woods, near a ditch running west from Berry Lake, Ind., and about one quarter of a mile from the lake. May, 1888. (B.)

CORALLORHIZA, Haller. Coral-root.

957. *C. innata*, R. Br.

South Chicago, *University of Chicago Herb.* Sand ridges, east of Berry Lake, Ind., *Hill!* June. (B. P.)

958. *C. multiflora*, Nutt.

Wooded ravines, northeast; infrequent or rare. July. (B.)

Riverside. Near Palatine. Berry Lake, Ind. Forest Hill; not common, *Hill*.

SPIRANTHES, Rich. Ladies' Tresses.959. **S. cernua**, Rich. Screw-stem.

Moist prairies; frequent, especially southward. August 15th—September.

960. **S. gracilis**, Bigel.

Wooded banks of ravines in the northern portion of Cook County; frequent. July—August.

Sandy soil of the southeast, infrequent or rare.

GOODYERA, R. Br.961. **G. pubescens**, R.Br. Rattlesnake Plantain.

Pine woods near Whiting, Ind., 1880, *Hill*/ (B.)

ARETHUSA, Gronov.962. **A. bulbosa**, L. Arethusa.

Bogs; rare. June. (B. P.)

Pine Station and Casella, Ind. Miller's, Ind., *Bastin*, *Hill*/ Marsh near South Chicago; now exterminated, *Bastin*.

CALOPOGON, R. Br.963. **C. pulchellus**, R.Br. Calopogon. Grass Pink.

Wet prairies and bogs; common south, rather local elsewhere. June 10th—August.

A form with white, or slightly pinkish flowers, is occasionally found.

POGONIA, Juss. Pogonia.964. **P. ophioglossoides**, Nutt.

In wet sandy soil and bogs, mainly southeast; common, locally abundant. June—July.

965. **P. pendula**, Lindl.

Wet pine barrens, Casella, Ind.; flowers white, or faintly tinged with pink, *Hill*/ Open pine woods in sandy soil, Miller's, Ind.; rare. August. (B.)

ORCHIS, L.966. **O. spectabilis**, L. Showy Orchis.

Moist rich woods; frequent. April 25th—May.

HABENARIA, Willd.967. **H. tridentata**, Hook. Rein-Orchis.

Wet rich woods; rare and scattered. June—July 15th. (P.)

Glencoe. Miller's and Casella, Ind. Wet grassy lands; Sheffield, Ind., *Hill*. Pine Station, Ind., *Bastin*/ Lake and Calumet, Ind., *Babcock*.

968. *H. virescens*, Spreng. Greenish Orchis.
Wet shaded woods and banks; rare. June 15th—July 5th.
Glencoe. Maywood. Grand Crossing. Berry Lake and Pine
Station, Ind. Riverside, *Babcock*! Wet pine woods, Edgemoor,
Ind., *Hill*.
969. *H. bracteata*, R.Br. Bracted Green Orchis.
H. viridis, R.Br., var. *bracteata*, Reich.
Moist woods and shaded banks; infrequent in the ravines north-
ward and in woods at Niles. Rare elsewhere. May.
Pine woods, Casella and Miller's, Ind. Pine Station, Ind., *Bastin*.
970. *H. hyperborea*, R.Br. Northern Green Orchis.
North Evanston. Bogs and wet woods near Miller's, Ind., *Hill*!
Pine Station; rare, *Babcock*, *Bastin*. June—July. (P.)
971. *H. hookeri*, Torr. Small Two-leaved Orchis.
Ravines of the northern portion of our district; rare. Rich woods
near Niles. Wet woods, Miller's, Ind. Glencoe, *Babcock*. River
Park, *Bastin*. Pine woods, Edgemoor, Ind., *Hill*. Winnetka,
Johnson. June.
972. *H. hookeri*, Torr., var. *oblongifolia*, Paine.
Pine woods, Edgemoor, Ind., *Hill*! June. (B. P.)
973. *H. ciliaris*, R.Br. Yellow Fringed-Orchis.
Sandy sloughs of the southeastern portion of our district; frequent.
July 15th—August.
974. *H. blephariglottis*, Torr. White Fringed-Orchis.
Two specimens near Stony Island, growing in the deep grass of a
swamp. July, 1887. (B. P.)
975. *H. leucophæa*, Gray. Greenish Fringed-Orchis.
Moist prairies and woods; frequent southward, rare elsewhere.
July—August.
976. *H. lacera*, R.Br. Ragged Fringed-Orchis.
Swamps and moist woods; infrequent south. July.
Casella, Ind. Normal, *Brennan*. Calumet, Ind., *Babcock*. Miller's,
Ind., *Hill*, *Bastin*!
977. *H. psycodes*, Gray. Purple Fringed-Orchis.
Wet grounds; rare. July. (B.)
Near Lake Calumet. Hog Island, *Williams*. Miller's, Ind., *Hill*,
Bastin. Englewood, *Indye*.

CYPRIPEDIUM, L.

978. **C. candidum**, Muhl. Small White Lady's Slipper.
Bogs; local. May 20th—June.
Ravenswood. Winnetka. Rose Hill. Hog Island. Englewood to South Chicago and southeast. Calvary, *Miss Belle Alling*.
979. **C. parviflorum**, Salisb. Smaller Yellow Lady's Slipper.
Rich low woods and bogs; local. May—June.
Ravines north of Evanston. Palatine. Calvary, *Miss Belle Alling*. Southeast; frequent.
980. **C. pubescens**, Willd. Larger Yellow Lady's Slipper.
Moist rich woods and bogs; frequent, especially in ravines northward; less frequent elsewhere. June.
981. **C. spectabile**, Swartz. Showy Lady's Slipper.
Chiefly in the bogs and sloughs of the southeastern portion of our district, where it is frequent; rare, northward. June—July.
It is said to have been abundant, a few years since, near Calumet, Ind., from which locality it has been nearly exterminated by florists.
A monstrous flower of this species, found June, 1881, at Pine Station, Ind., near the shore of Lake Michigan, had the following characteristics; it was borne on the same stalk with a flower which had the ordinary form of the species. Its organs were arranged in five alternating whorls, each of three pieces, save the third, which consisted of but two; the floral organs were adnate to the ovary; the stamens gynandrous, and the styles united as in the ordinary forms; but the ovary was not twisted, the stigmas were deeply and equally three-lobed, and the leaves of the perianth were equally developed, *Bastin, in his College Botany*.
982. **C. acaule**, Ait. Slender or Pink Lady's Slipper. Moccasin Flower.
Low places in sandy soil; west bank of the Calumet river, about one mile northeast of Calumet Heights on the B. & O. R. R. Local, *Bastin*. (B.)

HÆMODORACEÆ.**ALETIS, L.**

983. **A. farinosa**, L. Aletris. Colic-root. Star-Grass. Unicorn.
In sandy soil, from South Park, southward; frequent. Less frequent, north of Chicago. July—August 15th.

IRIDACEÆ.**IRIS**, Tourn.984. **I. versicolor**, L. Larger Blue Flag.

Swamps and wet places; common. May 25th—July.

SISYRINCHIUM, L. Blue-eyed Grass.985. **S. angustifolium**, Mill.*S. bermudiana*, L., var. *mucronatum*, Gray.

Moist grassy places; common, often abundant. June—September.

The white-flowered form is frequent locally.

986. **S. anceps**, Cav.*S. bermudiana*, L., var. *anceps*, Gray.

Moist prairies; frequent. May—June.

Near Stony Island. Grand Crossing. Edgemoor, Ind., *Johnson*.**AMARYLLIDACEÆ.****HYPOXYS**, L.987. **H. erecta**, L. Star-grass.

Meadows, lawns, roadsides, woods, etc.; common or abundant.

May 20th—August.

During the season of 1888, two or three plants were observed on a lawn near Garfield Park, Chicago, the flowers of which had twelve parts to the perianth.

DIOSCOREACEÆ.**DIOSCOREA**, Plumier.988. **D. villosa**, L. Wild Yam.

Rich woods; infrequent. July.

Niles. Riverside. South Park. Stony Island. Berry Lake and Miller's, Ind.

LILIACEÆ.**SMILAX**, Tourn.989. **S. herbacea**, L. Carrion-flower.

Moist banks and woods, especially southward; frequent. May 20th—June.

990. **S. rotundifolia**, L. Common Greenbrier.

Moist woods; frequent and scattered. June. (B.)

991. **S. glauca**, Walt. Greenbrier.Evanston. Niles. South Chicago, *Dodge*. Whiting, Ind., *Herman Jaeger*.

992. *S. hispida*, Muhl. Hispid Greenbrier.
Rich woods; infrequent. (B.)
Glencoe. Niles. Edgemoor, Ind., Johnson.

ALLIUM, L.

998. *A. tricoccum*, Ait. Wild Leek.
Rich and moist woods; frequent, especially southward. June 15th—
July.
994. *A. cernuum*, Roth. Wild Onion.
Prairies; common, abundant southward. July—August 10th.
995. *A. canadense*, Kalm. Wild Onion. Garlic.
Moist open woods and prairies; not common. May—June.

CAMASSIA, Lindl.

996. *C. fraseri*, Torr. Eastern Quamash. Wild Hyacinth.
Scilla fraseri, Gray.
Scilla esculenta, Ker.
Moist prairies, open woods and banks; frequent. May.

POLYGONATUM, Tourn.

997. *P. biflorum*, Ell. Smaller Solomon's Seal.
Open woods and shaded banks; frequent. May 15th—June.
998. *P. giganteum*, Dietrich. Great Solomon's Seal.
Banks of streams and lakes and moist woods; frequent. June.

ASPARAGUS, Tourn.

999. *A. officinalis*, L. Garden Asparagus.
Escaped from cultivation to roadsides and waste fields; infrequent.
May—June. (B. P.)

SMILACINA, Desf. False Solomon's Seal.

1000. *S. racemosa*, Desf. False Spikenard.
Moist shaded places; frequent. June.
With *S. stellata*, Desf.
1001. *S. stellata*, Desf.
Moist open woods and shaded banks; common. May—June.
1002. *S. trifolia*, Desf. Three-leaved False Solomon's Seal.
Bogs and wet banks; rare. May.
Roger's Park. Pine Station and Berry Lake, Ind. Gibson's, Ind.,
Babcock.

MAIANTHEMUM, Wigg.

1008. *M. canadense*, Desf. Two-leaved False Solomon's Seal.
Smilacina bifolia, Ker., var. *canadensis*, Gray.
Moist woods and banks; common. May—June 10th.

UVULARIA, L.

1004. *U. grandiflora*, Smith. Larger Bellwort.

Moist rich woods and shaded banks; common in the woods and ravines of the north, elsewhere frequent. April 25th—June.

OAXESIA, Watson.

1005. *O. sessilifolia*, Watson. Sessile-leaved Bellwort.

Uvularia sessilifolia, L.

Niles woods; rare. May. (B. P.)

ERYTHRONIUM, L.

1006. *E. americanum*, Ker. Yellow Adder's-tongue. Yellow Dog's-tooth Violet.

Low moist places; rare. April 15th—May.

Glencoe. Niles. Maywood, *Babcock*.

1007. *E. albidum*, Nutt. White Adder's-tongue or Dog's-tooth Violet.

Moist open woods and shaded places; frequent. April—May.

LILIUM, L.

1008. *L. philadelphicum*, L. Wild Orange Lily.

Usually in dry sandy soil; common eastward. July—August.

A specimen with two stamens changed to petals was collected at Englewood, *Hill*.

1009. *L. superbum*, L. Turk's-cap Lily. Wild Tiger Lily.

Moist and rich soil; infrequent, and chiefly southeast. July 15th—August.

Riverside; rare. Palatine; abundant, *Babcock*.

1010. *L. canadense*, L. Wild Yellow Lily.

Moist places; infrequent. July—August. (B.)

Wilmette. Hyde Park, *Bastin*.

MEDEOLA, Gronov.

1011. *M. virginiana*, L. Indian Cucumber-root.

Rich moist woods; infrequent, except locally. June.

Stony Island. Berry Lake, Ind. Gibson's, Ind., not common, *Babcock*. Miller's, Ind., *Hill*. Edgemoor, Ind., *Johnson*.

TRILLIUM, L.

1012. *T. sessile*, L. Sessile Trillium.

Rich moist woods; infrequent. May. (B.)

Northern and western portions of our district.

1013. *T. recurvatum*, Beck. Trillium.

Moist rich woods; common. May—June.

1014. *T. erectum*, L. Birth-root. Bath-flower.

Rich and open woods; infrequent. May—June 25th.

1015. *T. grandiflorum*, Salisb. Large White Trillium.

Rich woods and banks; common northward; less frequent south.
May.

An abnormal form with three typical and one shorter petal, about $\frac{1}{2}$ the size of the others, was collected at Winnetka.

A double-flowered form has been observed in the ravines near Glencoe; specimens with stalked sepals are not uncommon.

1016. *T. cernuum*, L. Nodding Trillium.

Moist rich woods and swamps; infrequent and scattered. May—June. (B.)

TOFIELDIA, Hudson.1017. *T. glutinosa*, Willd. False Asphodel.

Moist places. June—July.

From Hyde Park south and southeast; not common, except at Pine Station, Miller's and Edgemoor, Ind. Banks of the Desplaines river near Maywood; rare.

PONTEDERIAACEÆ.**PONTEDERIA**, L.1018. *P. cordata*, L. Pickerel-weed.

Aquatic and low swamps; frequent, or common locally. July—September 15th.

HETERANTHERA, Ruiz & Pav.1019. *H. graminea*, Vahl. Water Star-grass.

Schollera graminifolia, Willd.

Aquatic; frequent in the streams and ponds of the southeast, rare elsewhere. July 20th—August. (B.)

XYRIDACEÆ.**XYRIS**, Gronov.1020. *X. flexuosa*, Muhl. Yellow-eyed Grass.

Wet sandy swamps and bogs, from Sheffield, Ind., southward.
July—August.

COMMELINACEÆ.**COMMELINA**, Dill.1021. *C. virginica*, L. Day-flower.

Sandy hills at Miller's, Ind., *Babcock*!

Babcock reports it "abundant" in this locality. We do not find it so at the present time.

TRADESCANTIA, L.

1022. *T. virginica*, L. Common Spiderwort.

Moist open woods, prairies and fields; common or abundant.

June—August.

JUNCACEÆ.

- JUNCUS**, Tourn. Rush. Bog-rush.

1023. *J. effusus*, L. Common or Soft Rush.

Low banks of streams, lakes or swamps; frequent. July. (B.)

1024. *J. balticus*, Deth., var. *littoralis*, Engelm.

Sandy soil near the lake shore, both north and south; frequent south. June.

1025. *J. marginatus*, Rostk.

Three or four specimens were found on the lake shore near Whiting, Ind., July 25th, 1888. (B.)

Probably a waif from the East.

1026. *J. greenii*, Oakes & Tuck.

Whiting, Ind.; rare. July.

Miller's, Ind., 1878, *Bastin*. Sandy soil, east of railroad, about midway between Clarke & Tolleston, Ind., *Hill*. (B.)

1027. *J. tenuis*, Willd.

Low places; common. July. (B.)

1028. *J. gerardi*, Loisel.

Near Chicago, *Vasey*,—in *Plants of Illinois*. (B.)

1029. *J. bufonis*, L.

Low roadsides, banks and prairies; scattered. June—July.

1030. *J. alpinus*, Vill., var. *insignis*, Fries.

Wet sandy soil near the lake shore; rare. June—July. (B.)

South Chicago. Near Colehour and Casella, Ind. *Sheffield*, Ind., *Hill*.

1031. *J. acuminatus*, Michx.

Wet grounds near Pine Station, Ind. June. (B.)

Miller's, Ind., *Hill*.

1032. *J. scirpoides*, Lam.

Wet sandy soil; rare. August. (B. P.)

Miller's, Ind., *Bastin*/ Tolleston, Ind., *Hill*.

1083. *J. nodosus*, L.

Wet sandy places and swamps; frequent or common from Hyde Park southward, elsewhere infrequent or rare. July.

1084. *J. nodosus*, L., var. *megacephalus*, Torr.

Near Stony Island, 1888. Berry Lake, Ind., 1887. Pine Station, Ind., *Babcock*.

1085. *J. canadensis*, J. Gay.

Low grounds, chiefly southward; common. August—September. (B. P.)

1086. *J. canadensis*, J. Gay., var. *longicaudatus*, Engelm.

Wet sandy soil; frequent. August. (B.)

Tolleston and Pine Station, Ind. Miller's, Ind., *Hill*.

1087. *J. canadensis*, J. Gay., var. *brachycephalus*, Engelm.

Wet places; infrequent or rare. August. (B.)

Southeast from Englewood.

LUZULA, D C.1088. *L. campestris*, D C. Wood-Rush.

Fields and open woods; common or abundant. May.

Two forms are found:

(a) Decidedly hairy.

(b) Nearly smooth, or with a few scattered hairs.

TYPHACEÆ.**TYPHA**, Tourn.1089. *T. latifolia*, L. Common Cat-tail. Flag. Reed-Mace.

Aquatic or in swamps; common. June—July 15th.

1040. *T. angustifolia*, L. Narrow-leaved or Small Cat-tail.

T. latifolia, L., var. *angustifolia*, Wood.

Swampy places or aquatic. July. (B. P.)

"Skokie," Glencoe; rare. Liable to be found with the last. From South Chicago, south and southeast; frequent.

SPARGANIUM, Tourn. Bur-reed.1041. *S. eurycarpum*, Engelm.

Frequent in swamps and borders of lakes, from Hyde Park southward. June.

1042. *S. simplex*, Hudson.

Borders of ponds; not common. July. (B.)

South Chicago. Miller's and Tolleston, Ind. Pine Station, Ind., *Hill*!

1048. *S. minimum*, Fries.

Ponds and streams, southeast; rare. July. (P.)

Pine Station, Ind., *Babcock!* Clarke, Ind., short and partly out of water, *Hill*.

ARACEÆ.**ARISÆMA**, Martius. Indian Turnip.1044. *A. triphyllum*, Torr. Jack-in-the-Pulpit.

Moist woods and shaded swamps; common. April—June.

A form having acuminate leaflets with one or two lobes is occasionally found.

1045. *A. dracontium*, Schott. Green Dragon. Dragon-root.

Low shaded banks and wet woods; infrequent. May.

Often with the last.

PELTANDRA, Raf.1046. *P. undulata*, Raf. Arrow Arum.

P. virginica, Kunth.

In shallow water, chiefly south and southeast; infrequent. June—July. (B.)

SYMPLOCARPUS, Salisb.1047. *S. foetidus*, Salisb. Skunk Cabbage.

Wet banks, bogs and low woods; frequent. March—May, rarely as late as July.

In 1888 a few specimens were found with the spathe without spots or stripes.

ACORUS, L.1048. *A. calamus*, L. Sweet Flag. Calamus.

Margins of streams and wet or swampy places; occasionally in drier places, where the water accumulates and remains for a short time after a storm; common southward. May 15th—June 25th.

LEMNACEÆ.**SPIRODELA**, Schl.1049. *S. polyrrhiza*, Schl. Duckweed.

Lemna polyrrhiza, L.

Ponds and borders of slow streams; infrequent.

LEMNA, L. Duckweed.1050. *L. trisulca*, L.

In small ponds near Lake Calumet, 1884-'86, *C. P. Murray*. Lake Calumet, *Bastin!* Calumet river, near South Chicago, *Hill*. Not in flower in either locality. (B.)

1051. *L. perpusilla*, Torr.

Calumet Region; rare. A few fertile specimens were found near Hyde Lake, Ind., August 15th, 1884. (B. P.)

1052. *L. minor*, L.

In stagnant water; common.

Found in flower in July, 1886, *C. P. Murray*!

WOLFFIA, Horkel.1053. *W. columbiana*, Karsten. *Wolffia*.

South end of Berry Lake, Ind., in stagnant places, floating just beneath the water; $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long. Bayous of Calumet river, South Chicago, *Hill*! (B.)

ALISMACEÆ.**ALISMA**, L.1054. *A. plantago*, L. Water Plantain.

Aquatic; common. July—September.

SAGITTARIA, L. Arrowhead.1055. *S. variabilis*, Engelm. Common Arrowhead.

Aquatic or in swampy places; abundant. July—August.

The following varieties, or forms, are common and found with the type: *obtusa*, Gray; *angustifolia*, Gray; *gracilis*, Engelm. The latter on the authority of Babcock. A form with double flowers was found at Hinsdale by Mr. C. J. Fellows, *Babcock*, and a few similar specimens were collected near Pullman in 1885.

Var. *latifolia* occurs at South Chicago, *Williams*.

1056. *S. heterophylla*, Ph.

In swamps, chiefly southeast; infrequent. August. (B.)

1057. *S. heterophylla*, Ph., var. *angustifolia*, Engelm.

Near Miller's, Ind.; rare. (B. P.)

1058. *S. heterophylla*, Ph., var. *rigida*, Engelm.

Calumet river, near Miller's, Ind.; rare. August. (B. P.)

Calumet river, near South Chicago, *Hill*.

1059. *S. graminea*, Michx.

Ditches and swamps; frequent from Hyde Park south. July—August, sometimes as early as June 15th.

NAIADACEÆ.**TRIGLOCHIN**, L. Arrow-grass.1060. *T. palustris*, L.

A few specimens were noticed in a swamp near Sheffield, Ind.; rare. August, 1884-'85. (B.)

When looked for in 1887, they had disappeared. So far as known, this is the only locality within our limits where this species has been observed.

1061. *T. maritima*, L.

Marshy places from Woodlawn, southward, near the lake shore; not common. July—August.

North of Chicago; rare.

SCHEUCHZERIA, L.

1062. *S. palustris*, L. Scheuchzeria.

Miller's, Ind., *Bastin!* (B.)

POTAMOGETON, Tourn. Pondweed. (Arranged by Prof. E. J. Hill.)

1063. *P. natans*, L.

Common in ponds, ditches and rivers. July—August.

1064. *P. fluitans*, Roth.

P. lonchites, Tuck.

Aquatic, August, 1878, *University of Chicago Herbarium*. Chicago, *Babcock*. Desplaines river, near Desplaines, *W. K. Higley*. Deep ditches, South Chicago. July—September. (B.)

Frequent in the Calumet river, and usually growing, with very long stems, in deep water.

1065. *P. pulcher*, Tuck.

Rare, 1884 and 1885. June—August. (B.)

As yet found in but one place; in a slough by the roadside from Clarke to Pine Station, Ind. Perfect fruit found June 21st, but the upper leaves at that date were not full grown.

1066. *P. amplifolius*, Tuck.

Frequent in deep pools and ditches. August—September. (B. P.) Railroad ditches east of Englewood. South Chicago. Calumet river. Ponds in pine barrens, southeast.

The stems are often *branching*, and floating leaves frequently absent.

1067. *P. heterophyllus*, Schreb.

P. gramineus, Fries.

Desplaines river, near Riverside, *W. K. Higley*. July—September. Common in ditches and shallow ponds from Englewood eastward.

A species exceedingly variable, especially in the shape and size of its floating leaves, and the number of its submersed leaves, these sometimes being few, but often very numerous, and differing considerably in size. Specimens collected at Pine Station, Ind., have the fruit plainly keeled, and with two parallel ridges rather fainter than the keel, one on each side, becoming nearly or quite obsolete at the base of the fruit; submersed leaves short and numerous.

1068. *P. zizia*, Mertens & Koch.*P. lucens*, L., var. *minor*, Nolte.

Eastward from South Chicago, having about the same range there as *P. lucens*, and as common, especially at Pine Station, Ind. August—September. (B. P.)

Late in the season the plant sends up branches bearing immersed and shining leaves, by the lengthening of the stem beyond the earlier emerged ones, that at this time are submerged. (B. P.)

1069. *P. lucens*, L.

Throughout but infrequent, most common in ponds and small lakes of the Calumet Region from South Chicago eastward. August—September.

"Skokie." Cheltenham Beach. Riverside, University of Chicago Herbarium.

1070. *P. perfoliatus*, L., var. *lanceolatus*, Robbins.

Common in Calumet river and in lakes and ponds southeast of Chicago. July—October. (B. P.)

Quite variable in the length of the leaves, from $1\frac{1}{2}$ to $3\frac{1}{2}$ inches, those of the lower part of the stems are commonly shorter. All the plants collected from this vicinity, and nearly all throughout the West, are of the variety, and not of the type.

1071. *P. zosteræfolius*, Schum.*P. compressus*, Fries.

Infrequent. June—August. (B.)

Calumet river and ditches entering it. South Chicago.

1072. *P. pauciflorus*,* Ph.

Very common throughout, in shallow water of pools and ditches. June—September. (B)

Perfect fruit is sometimes found in the early part of June. Peduncles short, spikes capitate, 2 to 8 flowered. The forms in our vicinity nearly all approach the following variety, generally being plainly 8-nerved.

*This species, like several other Potamogetons, is quite variable, and the type and variety imperceptibly grade into one another. It sometimes occurs with hair-like stems, barely a foot in length, and with fine, short leaves, (Manistee, Mich.), or with stems 2 to 4 feet long, and with leaves 3 to 5 nerved, (as in the rapid water of the Pine river, at Poysippi, Wis.), where it is var. *niagarensis*. Those found in our limits are somewhat intermediate, the extremes of size not yet having been seen. None of the forms collected by us at the West exactly agree with the type of the var. *niagarensis*, which grows in the mill race at Niagara Falls, near the Cataract House.

1073. *P. pauciflorus*, Ph., var. *niagarensis*, Gray.

P. niagarensis, Tuck.

With the same general characteristics as the species, but more robust, and more apt to be in running water, though not exclusively so. Leaves longer, ($1\frac{1}{2}$ to $3\frac{1}{2}$ inches in length) and plainly 3 to 5 nerved, spikes 6 to 12 flowered. Same range. (B. P.)

1074. *P. pusillus*, L.

Frequent in still water, 2 to 3 feet deep, at South Chicago, and in pools and ditches at Englewood. July—August. (B.)

In both localities will be found forms with the leaves almost setaceous, (var. *tenuissimus*, Koch.)

1075. *P. mucronatus*, Schrad.

Common in ditches, near B. & O. R. R. shops, South Chicago. June—July, 1880-'81. (B. P.)

1076. *P. pectinatus*, L.

Common in streams and lakes of the Calumet Region, very abundant in railroad ditches at South Chicago. July—October.

The leaves of this species are quite variable, as well as the mode of branching. The leaves, especially on small plants, are commonly 1-nerved and setaceous, sometimes, particularly on larger forms, they are linear, bluntish, and with 3 to 5 double nerves. These forms usually branch but little, the leaves being arranged along the sides of the stems. Such forms might almost be taken for a different species. It is probable that the broad-leaved forms rarely perfect their fruit. Having first found them in 1880 at Manistee, Mich., they were thought to be *P. flabellatus*, Babington, (See Botanical Gazette, vol. 6, p. 262.) But the next year finding the same form among the Channel Islands of the St. Mary's river, and also in the Calumet river, an opportunity was given to study them at home. None of the plants found in August had mature fruit, as was also the case with those at Manistee and Sault Ste. Marie. Those in the Calumet river were again examined in October, but with no better result. But these forms from the Calumet had one character, as yet quite distinctive of *P. pectinatus*, and somewhat unique among Potamogetons, in abundance. They were well provided with bulbs or tubers on the creeping, underground stem. These appear in the Fall, (I have detected them as early as August 23rd,) and serve to make the species perennial. The slender axis joining the bulbs usually perishes, leaving them to start a new growth in the Spring. Sometimes they become detached and float on the water, but readily sink when the water is still. They abound in starch, and

serve to nourish the young plant. They seem especially numerous on the broad-leaved forms, and may take the place of fruit. Irmsch in his work (Ueber einige Arten aus der natürlichen Pflanzenfamilie Potameen, Berlin, 1858) gives a good description of them, with excellent figures, in an elaborate account of *P. pectinatus*. He compares these tubers or bulbs (Knolle) to those of *Crocus* and *Gladiolus*, and in their function of propagating the species to those of *Scirpus maritimus* and *Cyperus esculentus*, among *Monocotyledons*, and among *Dicotyledons* to the tubers of the potato and *Stachys palustris*.

NOTE.—Some species of the genus are found just beyond our limits, in Cedar Lake, Ind., and are likely to be found within them. These are *P. robbinsii*, Oakes, and *P. praelongus*, Wulfen. There are some indications of *P. vaseyi*, Robbins, having been found at S. Chicago, but as the specimens were imperfect, and not accessible now, or perhaps not in existence, it is deemed best to omit it. Aside from those given, and included in this note, no others are reported growing nearer than McHenry Co., that touches Cook County at the northwest corner. *P. vaseyi* (its original locality), *P. spirellus*, Tuckerman and *P. rufescens*, Schrader, are all reported from that county by Dr. George Vasey, and may be looked for in the neighboring parts of Cook County. *P. illinoensis*, Morong, may also occur here, as we find specimens of *P. amplifolius* with branching stems, but as it is a doubtful species at best, it may not be easy to establish its presence here.

ZANNICHELLIA, Micheli.

1077. *Z. palustris*, L. Horned Pondweed.

Pond near Cheltenham Beach; rare. July 16, 1888. (Form with fruit nearly sessile.) The form with peduncled fruit is more common, but intermediate forms occur, so that the distinctions on which var. *pedunculata*, Gray, are founded do not hold. Abundant in ditches at S. Chicago. Throughout in shallow water, but not abundant. July. (B.)

NAIAS, L.

1078. *N. flexilis*, Rostk. Schmidt. Naiad.

Ponds, shallow streams and lakes; common, especially in the Calumet Region. July—Aug. (B.).

CYPERACEÆ.

CYPERUS, Tourn. Cyperus. Gilingale.

1079. *C. flavescens*, L.

Evanston, Johnson. (B. P.)

1080. *C. diandrus*, Torr.

Low grounds; frequent southward, less frequent elsewhere. Aug.—Sept.

Abundant, especially south, Babcock.

1081. *C. diandrus*, Torr., var. *castaneus*, Torr.

With the type; infrequent. (B. P.)

1082. *C. aristatus*, Rottb.*C. inflexus*, Muhl.

In sandy soil near the lake shore, both north and south; frequent.
August—September.

1083. *C. schweinitzii*, Torr.

In sandy soil near the lake shore, south of Chicago; infrequent.
July—September 25th.

Miller's, Ind.; abundant, *Babcock*! Evanston, *Johnson*.

1084. *C. filiculmis*, Vahl.

Dry fields and banks; frequent or common southward. August—
September.

1085. *C. erythrorhizos*, Muhl.

Along I. C. R. R., between Oakland and Hyde Park; common, *Babcock*.

Generally infrequent.

1086. *C. esculentus*, L. Nut-Grass.*C. phymatodes*, Muhl.

Banks of a slough west of Berry Lake, Ind.; rare. August 25th,
1885, and September 5th, 1887. (B.)

1087. *C. strigosus*, L.

Damp fields and banks; the most common form of the genus.
August—October 15th. (B.)

1088. *C. speciosus*, Vahl.*C. michauxianus*, in *Manual*, 5th Ed.

Low sandy soil from Hyde Park southward; infrequent or rare.
August—October.

1089. *C. engelmanni*, Steud.

Low grounds at Forsyth, Indiana, September, 1879, *Hill*. (B.)

1090. *C. ovularis*, Torr.

Sandy fields; rare. September, 1889. (B.)

East Chicago, Ind.; plants 8 inches to 2 feet high, spike 2 to 8 flowered, *Hill*.

DULICHIMUM, Pers.1091. *D. spathaceum*, Pers. *Dulichium*.

Borders of ponds and sloughs in the Calumet Region, south to Miller's,
Ind.; common, elsewhere infrequent. July 25th—September.

ELEOCHARIS, R.Br. Spike-Rush.**1092. *E. capitata*, R.Br.**

"Found in a single locality in a slough south of Whiting, Ind., August 29th, 1881, and described in Botanical Gazette, VII, 8 (1882), as *E. dispar*."

Elsewhere in the United States, *E. capitata* ranges, as far as reported, throughout the Gulf States from Florida to Texas, New Mexico, Oregon and the borders of Colorado Desert. It is found in Mexico and several of the West India islands. As far as I have ever seen in examining many of the plants at Whiting, they have but *two* stamens, though the number of stamens in species of *Eleocharis* is not constant, and is not regarded as reliable in characterization. It is an annual plant in our district, without rhizomes to perpetuate it. Having observed it for several years, I find that the seeds germinate in the latter part of June, in the water or mud.

On looking for the plant the present season, (1889) the stems were about $\frac{1}{2}$ inch high, the first of July, thickly covering the ground in spots. On examining the plants about the middle of October, all were dead, root and stem, although dried stalks were plentiful. Its season, therefore, is from three and one-half to four months," *Hill!* (B. P.)

1093. *E. ovata*, R.Br.

E. obtusa, Schultes.

Moist places, muddy banks and sloughs; infrequent. June 25th—August 10th.

Hyde Park and south; common, *Babcock*.

We do not find this species at all common south of Chicago.

1094. *E. palustris*, R.Br.

Aquatic, and muddy banks; common, especially southward. June—July. (B.)

1095. *E. palustris*, R.Br., var. *glaucescens*, Gray.

In shallow water from Englewood eastward; common. (B.)

Usually found with the type.

1096. *E. intermedia*, Schultes.

Hyde Park, *Bastin*. (B.)

1097. *E. tenuis*, Schultes.

Wet prairies, borders of sloughs, etc.; common. June 15th—August 15th. (B.)

1098. *E. compressa*, Sullivant.

Wet prairies; frequent southward. (B.)

1099. *E. acicularis*, R.Br.

Muddy places; common. June—July. (B.)

1100. *E. pauciflora*, Link.

Wet, sandy soil, south of Whiting, Ind., *Hill*! (B. P.)

FIMBRISTYLIS, Vahl.1101. *F. spadicea*, Vahl., var. *castanea*, Gray.

F. castanea, Vahl.

Damp prairies; frequent, at least locally. July. (B.)

Englewood and southeast, also at Waukegan, Lake County, Ill., *Hill*!

1102. *F. laxa*, Vahl.

Hyde Park; common, *Babcock*.

We have seen only doubtful specimens of this species from our district.

1103. *F. autumnalis*, Roem. & Schultes.

Moist sands. August—September. (B.)

At Tolleston and Whiting, Indiana, it is local but abundant.

Specimens found at Whiting have the nut covered with stipitate tubercles, or wart-like projections. These are mentioned by Torrey in his "Cyperaceæ," under *Trychostylis mucronulatus*, and in Chapman's *Flora*, *Hill*!

1104. *F. capillaris*, Gray.

Dry, sandy soil; infrequent. July—August. (B.)

SCIRPUS, Tourn. Bulrush or Club-Rush.1105. *S. subterminalis*, Torr.

Ponds; infrequent. July. (B. P.)

Pine Station, Ind., *Hill*. Near Whiting, Ind.

1106. *S. pungens*, Vahl.

Sloughs of the Calumet Region and eastward; frequent. July. (B.)

1107. *S. lacustris*, L. Great Bulrush.

S. validus, Vahl.

Aquatic and swamps; frequent or common, especially in the Calumet Region and northern Indiana. July.

1108. *S. debilis*, Ph.

Wet places; frequent. August.

At Miller's, Ind., Prof. Hill has found plants with the bristles usually five in number.

1109. *S. fluviatilis*, Gray. River Bulrush.

Borders of lakes and streams from South Chicago, south and south-east; frequent. July—August.

1110. *S. atrovirens*, Muhl.

Frequent in wet prairies and bogs. June—July. (B.)

ERIOPHORUM, L. Cotton-Grass.1111. *E. lineatum*, Benth. & Hook.

Scirpus lineatus, Michx.

Low prairies; frequent. June—July. (B.)

South Chicago, *Hill*. Calumet Region and east; infrequent.

1112. *E. cyperinum*, L. Wool-Grass or Rush.

Scirpus eriophorum, Michx.

Wet places; infrequent or rare. (B.)

West of Berry Lake, Ind., frequent in 1886.

Very variable. Possibly variety *laxum*, Gray, may be found within our limits.

1113. *E. virginicum*, L.

Sloughs and swamps, chiefly from the Calumet Region, east; common. July—August.

1114. *E. polystachyon*, L.

Wet prairies and bogs; common, especially in the southern portions of our district. May 20th—July 15th.

1115. *E. polystachyon*, L., var. *latifolium*, Gray.

Found with the type. (B. P.)

1116. *E. gracile*, Koch.

Sheffield, Ind.; rare. Miller's and Pine Station, Ind. May—July 10th.

South Chicago, *University of Chicago Herbarium*. (B.)

HEMICARPHA, Nees.1117. *H. subsquarrosa*, Nees.

Includes var. *drummondii*, in Manual, 5th Ed.

Damp sandy soil; rare. July. (B.)

Miller's, Ind., 1880, *Hill*! This form is the variety *drummondii* of the 5th Edition of the Manual. Also found at Berry Lake, Ind., 1890.

The nearest point at which the type has been found is Laporte, Ind.

RHYNCHOSPORA, Vahl. Beak-Rush.1118. *R. cymosa*, Nutt.

Not common. Miller's, Ind., August 8th, 1876. Tolleston, Ind.

Prof. Hill first detected this plant at Kankakee, Ills., in 1870, and the second time at Miller's, Ind. It grows in some localities with *R. glomerata*, Vahl., but is much less common. (B.)

1119. *R. alba*, Vahl.

Three specimens were found near Grand Crossing, August 5th, 1886. (B.)

1120. *R. capillacea*, Torr., var. *leviseta*, E. J. Hill (Am. Nat., Vol. X., June, 1876, p. 870.)

Frequent in wet sands at Pine Station, Edgemoor and Whiting, Ind. First discovered at Pine Station in 1875, and frequently found since then; bristles *perfectly smooth*, but not otherwise differing from the type. All the specimens in our district, yet examined, are of the variety, not the type; found also at Torch Lake, Mich., with the type, *Hill!* (B. P.)

1121. *R. glomerata*, Vahl.

Wet places; frequent south and southeast. July—September.

CLADIUM, P. Br.1122. *C. mariscoides*, Torr. Twig-Rush.

Near the south end of Lake Calumet; rare. July 1883-'85. Pine Station, Ind., 1889. Cook County, *Scammon*,—in *Bebb's Herb. at Northwestern University*. (B.)

Abundant in marsh east of Englewood, *Hill*.

SOLERIA, Berg. Nut-Rush.1123. *S. triglomerata*, Michx.

Southern portions of the Calumet Region; infrequent. June 15th—August.

Miller's, Ind. Evanston, *Boltwood*. Common at Pine Station, Ind., *Hill!*

1124. *S. verticillata*, Muhl.

Sandy borders of sloughs near Miller's, Ind.; rare. August, 1888. (B. P.)

CAREX, Ruppius. Sedge.1125. *C. intumescens*, Rudge.

Wet places; common or abundant. May—July. (B.)

1126. *C. grayii*, Carey.

Wet banks; generally rare. May 10th—July.

Thatcher. Riverside. Swamps near Stony Island, a single specimen, 1885. Near banks of Desplaines river; abundant, *Babcock*. Hobart and Wheeler, Ind., *Hill*.

1127. *C. lupulina*, Muhl.

Wet places; frequent, especially southward. May 25th—July 15th. (B.)

"A variable and perplexing species," *Bailey*.

1128. *C. lupulina*, Muhl., var. *pedunculata*, Dew.

With the type; frequent, (B. P.)

NOTE.—*C. lupulina*, Muhl., var. *polystachya*, Schwein & Torr.

C. lupuliformis, Sartw.

Glencoe; rare, *Babcock*.

Babcock's specimen is not available, and as the writers have never been able to find this form, and, as it is easily mistaken for var. *pedunculata*, think it possible there may have been a mistake in identification.

1129. *C. utriculata*, Boott.

Sloughs from Sheffield south to Pine Station, Ind.; infrequent. June. (B.)

1180. *C. monile*, Tuck.

In wet places; not common. June—July. (B.)

1181. *C. lurida*, Wahl.

C. tentaculata, Muhl.

Wet prairies and sloughs; common or abundant. June 15th—July. (B.)

1182. *C. hystericina*, Muhl.

Wet prairies and banks; common, especially southward. May 15th—August.

Pine Station, Ind.; abundant, *Babcock*!

1188. *C. pseudo-cyperus*, L., var. *americana*, Hochst.

C. comosa, Boott.

Swamps of the Calumet Region; infrequent. June.

Pine Station and Gibson's, Ind.; not common, *Babcock*!

Borders of Calumet Lake, *Bastin*.

Sloughs, East Chicago, Ind., 1889, where some of the plants were remarkable for the character of the staminate spikes, which had fertile flowers variously intermixed, sometimes one-half fertile, usually the upper part. In this respect it resembled *C. hystericina*, Muhl., as sometimes found. However, the majority of specimens were usually typical, *Hill*.

1184. *C. squarrosa*, L.

Sloughs near Casella, Ind.; rare. June, 1888.

Wheeler, Ind., *Hill*. (B.)

1185. *C. scabrata*, Schwein.

Wet borders of sloughs from Colehour, Ind., southward; rare. May. (B. P.)

Evanston. Niles' woods, 1886. Grand Crossing, 1889.

1186. *C. filiformis*, L.

Sloughs throughout the Calumet Region and south to Miller's, Ind.; infrequent or rare. May—June.

Pine Station, Ind., *Babcock*/ Morgan Park, *Hill*.

1187. *C. filiformis*, L., var. *latifolia*, Boeckl.

C. lanuginosa, Michx.

Wet places; common. May—July.

1188. *C. riparia*, W. Curtis.

Sloughs near Cassella and Miller's, Ind.; infrequent. May 25th—July 5th. (B.)

Clarke, Ind.; sterile spikes usually 8; uppermost usually stalked; leaves variable, about 4 inches wide, *Hill*.

1189. *C. fusca*, All.

C. buzbaumii, Wahl.

Bogs, Hyde Park, south to Miller's, Ind.; common, infrequent elsewhere. May—July 25th.

Specimens from Clarke, Ind., had the uppermost spike staminate at the apex, as well as at the base, May, 1881, *Hill*.

1140. *C. vulgaris*, Fries.

Banks of the Calumet river, near L. S. & M. S. R. R. bridge. June 25th, 1887. (B. P.)

But two specimens of this species, evidently introduced from the East, were found. This is the only record of its occurring within our limits. Having looked for it repeatedly since 1887, we are convinced that the two plants were merely waifs, and that it has disappeared altogether.

1141. *C. stricta*, Lam.

Wet prairies and peat bogs; common, especially southward. May 15th—June.

1142. *C. stricta*, Lam., var. *decora*, Bailey. (Bot. Gaz. xiii., '85.)

C. aperta, in Manual, 5th Ed.

Woods at Riverside; abundant, *Babcock*. Evanston, *Johnson*.

C. aperta, Boott, is a plant of the Pacific Coast; the name being founded on specimens collected by Scoules & Douglas in the Columbia river. Boott made a variety b, founded on specimens from the Eastern United States. This is the *C. aperta* of Gray's Manual, 5th Edition.

Prof. Hill reports the following note concerning a specimen collected at Kankakee, Ill., in 1872: Spikes rather short, (as compared with *C. aperta*), the perigynia covered with minute, transparent dots; some of the scales barely as long as the perigynium.

1148. *C. aquatilis*, Wahl.

Desplaines river, near Desplaines; rare, 1889. Lake Calumet, near the southern end; rare, 1886. Calumet river, near South Chicago; infrequent. June. (B.)

Sterile spikes rarely four. A form with long and narrow leaves, with the fertile spikes quite short, $1\frac{1}{2}$ to 2 inches long, is occasionally met with. Plants 2 to 5 feet high.

1144. *C. crinita*, Lam.

Banks of streams and wet places; frequent. (B.)

1145. *C. gracillima*, Schwein.

Sloughs; rare. May—June. (B. P.)

Pine Station and Miller's, Ind.

A form with scales obtuse or with a short point was found in wet places in woods west of Clarke, Ind., 1889, *Hill*.

1146. *C. grisea*, Wahl.

Moist places; infrequent.

South Park. Pullman. Riverside. *Brennan*. Desplaines, *C. P. Murray*. (B. P.)

1147. *C. granularis*, Muhl.

Wet places north of Lake Calumet; infrequent. May.

At Clarke, Ind., in moist or even dryish soil, *Hill*. (B.)

1148. *C. crawei*, Dew.

Sloughs and wet places, especially south; frequent. June.

1149. *C. flava*, L., var. *viridula*, Bailey.

C. æderi, in Manual, 5th Ed.

Lake shore from South Chicago, south to Pine Station, Ind.; frequent. May—June. (B. P.)

Bluffs near Evanston, *Miss Frances Towls*. Rose Hill, *Johnson*.

Prof. Hill reports the following: I find this abundant in wet sands from Englewood east. It delights particularly in railway excavations when not too wet, growing in extensive patches and thickly covering the ground.

1150. *C. conoidea*, Schk.

Moist prairies; infrequent, especially southward. May 25th—June. (B.)

1151. *C. oligocarpa*, Schk.

Woods; rare. June.

Forest Hill, also Hobart, Ind., *Hill*! (B.)

Bailey remarks: "I find that in general, botanists have not a clear conception of this species. Distinguished from *C. grisea*, var.

angustifolia, with which it is sometimes confounded, by its smaller perigynium, which is abruptly contracted at its middle into a conspicuous beak."

It is likely also to be confounded with some forms of *laxiflora*, when the latter bears few fruits, but in the finely striated perigynium, I have found one of the best discriminations, *Hill*.

1152. *C. laxiflora*, Lam.

Open woods, fields, etc.; frequent. May 20th—July 15th, often as late as October.

1153. *C. laxiflora*, Lam., var. *striatula*, Carey.

Var. *blanda*, Boott.

Common or abundant. May—June. (B. P.)

1154. *C. laxiflora*, Lam., var. *patulifolia*, Carey.

Var. *plantaginea*, Boott.

Near Stony Island; rare, 1886. Berry Lake, Ind.; rare, 1888. (B. P.)

NOTE.—A very variable species, the varieties growing in similar localities with the type.

Var. *intermedia*, Boott, of Gray's Manual, 5th Ed., which is frequently found within our limits, is now regarded by Bailey as the type form.

1155. *C. careyana*, Torr. Carey's Sedge.

Shaded ravines north of Evanston; very rare. May. (B.)

This is also found beyond our limits in ravines made by the brooks of the Calumet river about its sources at Otis, Ind., *Hill*.

1156. *C. plantaginea*, Lam.

Shaded banks and rich open woods; infrequent. May—June. (B. P.)
Glencoe. Evanston. Niles. Riverside. Casella, Ind., and southward.

1157. *C. saltuensis*, Bailey.

C. vaginata, Tausch.

Sloughs between Pine Station and Clarke, Ind.; rare. June, 1887-'89.

Moist slopes near sloughs, with *C. granularis*, Muhl., Clarke, Ind., May, 1881, *Hill*. (B. P.)

1158. *C. tetanica*, Schk.

Common south and east, less frequent in the northern portion of our district.

1159. *C. tetanica*, Schk., var. *meadii*, Bailey. Mead's Sedge.

C. meadii, Dew.

C. meadii, Dew., var. *bebbii*, Arthur.?

In wet places. May—June 25th.

From Sheffield, south to Pine Station, Ind.; rare. Hinsdale, Du Page County; common, *Babcock*.

1160. *C. aurea*, Nutt.

Banks of streams, sloughs, etc., from Hyde Park southward; frequent. May 20th—July, often as late as September.

Moist woods at Niles; rare. Pine Station, Ind.; abundant, *Babcock*!

Sterile spikes with fertile flowers at the apex, Whiting and Pine Station, Ind., *Hill*.

1161. *C. eburnea*, Boott.

Dry sands, Pine, Ind.; common where found, but apparently limited in range, *Hill*. (B. P.)

1162. *C. richardsoni*, R.Br.

Dry sands, Pine Station, Ind.; infrequent. May. (B.)

Apt to be overlooked, and taken for *C. pennsylvanica*, Lam.

1163. *C. varia*, Muhl.

C. emmonsii, Dew.

Sandy woods, Whiting to Miller's, Ind.; infrequent. May—June. (B.)

Varies somewhat. Bracts longer than the culm, Whiting, Ind., June, 1880; without radical peduncle and with green spikes, East Chicago, Ind., May, 1886. Generally grows in tufts, sometimes very dense, in dry sandy soil, and usually with both kinds of spikes, the peduncled one from the base, and the others, 2 to 4, crowded near the top of the culm.

1164. *C. pennsylvanica*, Lam.

Dry banks and open woods; common throughout.

1165. *C. communis*, Bailey.

C. varia, in Manual, 5th Ed.

Dry open woods in the northern part of the county; not frequent, more frequent southward. (B.)

1166. *C. umbellata*, Schk.

Dry banks; infrequent. May—June. (P.)

Evanston. Niles. Sheffield, Ind. Pine Station, Ind.; common, *Babcock*!

1167. *C. pubescens*, Muhl.

Moist banks and open woods; infrequent. May—June. (B.)

Riverside and Stony Island; rare. Maywood. Evanston, *Johnson*.

1168. *C. jamesii*, Schwein.*C. steudelii*, Kunth.

A single specimen was found June 5th, 1885, in woods near Jackson Park. Near Chicago, Vasey. (B.)

1169. *C. polytrichoides*, Muhl.

Wet prairies and swamps; frequent. May. (B.)

1170. *C. stipata*, Muhl.

Low places; common. May. (B.)

1171. *C. crus-corvi*, Shuttlew.

Swamps; rare. (B.)

Sloughs near Berry Lake, Ind., 1884. Pine Station, Ind., 1884. Riverside, Munroe.

1172. *C. teretiuscula*, Gooden.

Sloughs, near Pine Station, Ind.; infrequent or rare. May—June. (B.)
Niles; rare. Clarke, Ind., Hill.

1178. *C. ALOPECOIDEA*, Tuck.

Woods at Miller's, Ind.; rare, May, Hill! (B. P.)

1174. *C. vulpinoidea*, Michx.

Low places; common. June—July 10th. (B.)

Perigynia occasionally lanceolate with the beak long and quite entire.

This is seemingly a late flowering form, July 15th to 25th.

1175. *C. sartwellii*, Dew.

C. disticha, in Manual, 5th Ed.

Border of sloughs, near Miller's, Ind.; rare. May, 1888. (B.)

Middle spikes all staminate, Evanston, Johnson.

1176. *C. tenella*, Schk.

Near Evanston, Johnson. (B. P.)

Berry Lake and Casella, Ind.; rare

1177. *C. rosea*, Schk.

Moist meadows and shaded banks; common. May—June 20th. (B.)

1178. *C. rosea*, Schk., var. *radiata*, Dew.

With the type. May—June 10th. (B. P.)

Includes Var. *minor*, Boott., which is fully as common as the species.

1179. *C. sparganioides*, Muhl.

Low places and rich open woods; common. May—June 20th. (B.)

A form with the spikes branched is quite frequently found.

1180. *C. muhlenbergii*, Schk.

Frequent in dry open woods and on sandy ridges, from South Chicago, south. June—July.

Lake shore near Kenwood. Jackson Park, 1889, culm 2 feet high; perigynia ovate, longer than the mucronate scale, margins rough. Evanston, Boltwood.

1181. *C. cephalophora*, Muhl.

Open and rich woods and old fields; common. May. (B.)

Upper spike sometimes entirely staminate.

1182. *C. echinata*, Murray, var. *microstachys*, Boeckl.

C. sterilis, Willd.

C. stellulata, L., and var. *scirpoides*, Gray.

Wet places and sloughs; frequent, especially southward. May—June 15th.

Common at Clarke and Miller's, Ind., Hill.

1183. *C. canescens*, L.

Bogs near Pine Station, Ind.; rare, 1885. (B. P.)

1184. *C. canescens*, L., var. *apicola*, Wahl.

C. canescens, L., var. *vitis*, Carey.

C. vitilis, Fries.

Wet grounds. June. (B. P.)

A tall and slender form varying in the proximity of the heads, East Chicago, Ind., 1889, Hill.

1185. *C. bromoides*, Schk.

Swamps of the Calumet Region and south; infrequent. May—June. (B. P.)

Evanston, Johnson. Otis, Ind., Hill.

In 1887 the dioecious form was frequent.

1186. *C. muskingumensis*, Schwein.

C. arida, Schwein. & Torr.

Near Chicago, Northwestern University Herb. Wheeler, Ind., just south of our limits, Hill. (B.)

1187. *C. tribuloides*, Wahl.

C. lagopodioides, Schk,

Moist open woods and banks; frequent in the northern portion of our district. June—July 10th. (B.)

Evanston. Niles. Palatine. Desplaines. Riverside.

With some heads compound at the base, East Chicago, Ind., June, 1889, Hill.

1188. *C. tribuloides*, Wahl., var. *cristata*, Bailey.*C. cristata*, Schwein.Moist fields, open woods and prairies; frequent. May 25th—June.
(B. P.)1189. *C. scoparia*, Schk.

Low places; frequent, especially south. June 15th—July.

With dense heads, Colehour, Ind., 1875, *Hill*.1190. *C. FGENEA*, Willd.*C. adusta*, in Manual, 5th Ed.Evanston, 1886, and in 1889, *Johnson*. (B.)1191. *C. straminea*, Willd.*C. straminea*, var. *tenera*, in Manual, 5th Ed.

Prairies, wet places and open woods. June—August. (B.)

The typical form is quite frequent, but the species varies greatly.

1192. *C. straminea*, Willd., var. *brevior*, Dew.*C. straminea*, and vars. *typica*, *hyalina*, and *meadii*, in Manual, 5th Ed.

Frequent, with the type. June. (B.)

1198. *C. straminea*, Willd., var. *aperta*, Boott.

Bogs; infrequent. (B. P.)

Heads short or broadly conical, often loose or nodding, with narrow perigynium, *Hill*.1194. *C. straminea*, Willd., var. *alata*, Bailey.*C. alata*, Torr.

Bogs, among bushes; rare. (B. P.)

Tolleston, Ind., 1878-'80; tall, 8 to 3½ feet in height, with large tapering spikes, and broadly winged perigynium, *Hill*! In wet sandy soil, East Chicago, Ind.

NOTE.—Perhaps others of the varieties enumerated in Bailey's "Synopsis of North American Carices," and "Studies of the Types," may occur within our limits, but the species and these three varieties are all that it is safe to admit with present material.

GRAMINEÆ.

SPARTINA, Schreb.

1195. *S. cynosuroides*, Willd. Fresh-water Cord-Grass. Marsh-Grass.

Low banks of streams and lakes; common, especially in the southern portion of our district. August.

PANICUM, L. Panic Grass. Crab-Grass.

1196. *P. GLABRUM*, Gaudin.

On railroad near the Stock Yards; rare, *Babcock*.

1197. *P. SANGUINALE*, L. Common Crab-Grass.

In waste places and cultivated grounds; frequent or common.
August—September.

1198. *P. capillare*, L. Old-witch Grass.

In dry sandy soil and cultivated fields; common. Aug.—Sept.

1199. *P. autumnale*, Bosc.

Sand ridges, south of Whiting, Ind.; rare. August 25th, 1885. (B.)

1200. *P. virgatum*, L.

Maywood, *Babcock*. Frequent along the sands of the lake shore.
August.

1201. *P. latifolium*, L.

Moist and wet woods; common. June—September.
Lower sheaths sometimes rough and hairy, *Hill*.

1202. *P. clandestinum*, L.

Low rich woods and banks; not rare. July. (B.)
Niles. Maywood. Palatine. Stony Island. Colehour and Berry
Lake, Ind.

1203. *P. scoparium*, Lam.

P. pauciflorum, Ell.

Wet copses, near Sheffield, Ind.; infrequent. July, *Hill*. (B.)

1204. *P. depauperatum*, Muhl.

Dry open woods; common. June—July.
Said to be abundant in the hilly woods of the northern part of Cook
County.

1205. *P. dichotomum*, L.

Meadows, prairies and open woods; common or abundant, June—
July 15th.

1206. *P. laxiflorum*, Lam.

Meadows, etc.; frequent. June—July. (B.)
Closely resembles the last, and may be passed over by the collector.

1207. *P. CRUS-GALLI*, L. Barnyard Grass.

Rich soil and cultivated ground; frequent.. August—September.

1208. *P. CRUS-GALLI*, L., var. *HISPIDUM*, Torr.

Ditches, near Stony Island; infrequent. Swamps at Forsythe,
Ind., *Hill*. (B.)

SETARIA, Beauv.

1209. *S. VERTICILLATA*, Beauv. Bristly Fox-tail Grass.

Cultivated grounds near 65th St.; rare. July 25th, 1888. (B.)

1210. *S. GLAUCA*, Beauv. Pigeon Grass. Fox-tail Grass.

Fields and roadsides; common or abundant. July—August.

1211. *S. VIRIDIS*, Beauv. Bottle-Grass.

Cultivated and waste grounds; frequent. July—September.

1212. *S. ITALICA*, Kunth. Bengal Grass. Millet.

Spontaneous in cultivated grounds; rare. June—July. (P.)

CENCHRUS, L.

1213. *C. tribuloides*, L. Hedgehog-Grass. Bur-Grass.

Common in the eastern portion of our district; frequent elsewhere.
August—September 15th.

LEERSIA, Swartz.

1214. *L. virginica*, Willd. White Grass.

Damp, rich, open woods and shaded banks; common. August—
September 15th.

1215. *L. oryzoides*, Swartz. Rice Cut-grass.

Sloughs and wet places throughout the southern part of our district;
common, infrequent elsewhere. July 25th—August.

ZIZANIA, Gronov.

1216. *Z. aquatica*, L. Indian Rice. Wild Rice. Water Oats.

Low places that are under water a portion of the season, sloughs and
borders of lakes; frequent in the Calumet Region, elsewhere less
common. August.

It seems to prefer the shallow borders of lakes, near the outlet or
inlet, and in favorable localities it attains a height of 10 or 12 feet.
The leaves vary in length from 1 to 4 feet.

In the far northwest, where it is very abundant, it is of considerable
importance as a food product, and is used extensively by the
Indians.

ANDROPOGON, Royen. Beard-Grass.

1217. *A. furcatus*, Muhl.

Rather dry soil; common. August.

1218. *A. scoparius*, Michx.

In dry soil, especially north and west; frequent. August. (B.)

1219. *A. virginicus*, L.

A. dissitiflorus, Michx.

Sandy soil at Englewood; infrequent, September, Hill. (B.)

CHRYSOPOGON, Trin.1220. *C. nutans*, Benth. Indian Grass. Wood-Grass.*Sorghum nutans*, Gray.

In rather dry or sandy woods and fields; frequent. Aug.—Sept.

PHALARIS, L.1221. *P. CANARIENSIS*, L. Canary-Grass.Near Woodlawn Station, 1887. Garfield Park, 1888. 20th St., near railroad, *Babcock*. Rare. August. (P.)1222. *P. arundinacea*, L. Reed Canary-Grass.

Wet places; infrequent. June—August.

Banks of the Desplaines river; frequent.

HIEROCHLOA, Gmelin.1223. *H. borealis*, Roem. & Schultes. Vanilla Grass.

Moist meadows; rare and not far from the lake shore. May. (B.)

ARISTIDA, L.1224. *A. tuberculosa*, Nutt. Triple-awned Grass.

Dry sandy soil; frequent south. August. (B.)

STIPA, L.1225. *S. spartea*, Trin. Porcupine Grass.

We have identified a few specimens of this species from west of Crawford.

Evanston, *Boltwood*. Grand Crossing, *Babcock*. Englewood and Miller's, Ind., *Hill*, who also reports it as common in the southern part of the county.**MUHLENBERGIA**, Schreb. Drop-seed Grass.1226. *M. sobolifera*, Trin.

Woods at Stony Island; rare. August, 1884-'85. (B.)

1227. *M. glomerata*, Trin.

Usually found in wet or swampy places, but occasionally in dry sandy soil; infrequent or rare. August.

Near Altenheim. Colehour, Ind. Riverside, *Herman Jaeger*. Desplaines river, near Maywood, *Babcock*.1228. *M. mexicana*, Trin.

Low prairies and swampy places; frequent. July 25th—September.

1229. *M. sylvatica*, T. & G.Desplaines river, near Maywood, *Babcock*!1280. *M. willdenovii*, Trin.Desplaines river, near Maywood, *Babcock*. Desplaines. Stony Island.

BRACHYELYTRUM, Beauv.1281. **B. aristatum**, Beauv.

Along the banks of the Desplaines river from Riverside to Maywood;
rare. June, 1886-'87. (B.)

PHLEUM, L.1282. **P. PRATENSE**, L. Timothy.

Common in cultivation, also spontaneous throughout our district, in
rich soil. June—September.

ALOPECURUS, L.1283. **A. geniculatus**, L., var. **aristulatus**, Torr.

A. aristulatus, Michx.

In wet places and the shallow waters of sloughs; frequent or com-
mon. June 15th—August. (B.)

SPOROBOLUS, R.Br. Drop-seed or Rush-Grass.1284. **S. vaginæflorus**, Vasey.

Vilfa vaginæflora, Torr.

Old fields and banks in sandy soil; common. August—September.
Maywood; abundant, *Babcock*.

1285. **S. junceus**, Kunth.

Sandy soil, north of Normal Park, near 74th St.; rare, Aug., 1886.
Hill. (B. P.)

1286. **S. heterolepis**, Gray.

Common near the lake shore, *Babcock*.

Our investigation does not confirm *Babcock*. We find it rather in-
frequent, and as far west as Riverside.

1287. **S. cryptandrus**, Gray.

Sandy soil near Northwestern University. A few specimens were
found near the lake shore at Sheffield, Ind., in Aug., 1887. (B.)

At Sheffield, stems geniculate, sheaths bearded along the edge, root
perennial, *Hill*.

AGROSTIS, L.1288. **A. ALBA**, L., var. **VULGARIS**, Thurb. Red-top. Herds'-Grass.

A. vulgaris, With.

Meadows; frequent.

1289. **A. perennans**, Tuck. Thin-Grass.

Damp open woods and shaded banks; infrequent. July.

Niles' woods. Stony Island. Maywood, *Babcock*. River Forest, *C.*
P. Murray.

1240. *A. scabra*, Willd. Hair-Grass.

Prairies; common. July.

CINNA, L.1241. *C. arundinacea*, L. Wood Reed-Grass.

Moist or wet shaded places; frequent, especially along river banks.

July—September.

CALAMAGROSTIS, Adans.1242. *C. canadensis*, Beauv. Blue Joint-Grass.

Deyeuxia canadensis, Beauv.

Wet places; frequent throughout our district. July 5th—Aug. 25th.

By its strong rhizomes and roots it tends to hold together the shifting sands of the lake shore dunes.

1248. *C. longifolia*, Hook. Reed Bent-Grass.

Ammophila longifolia, Benth.

Sandy soil along the lake shore, both north and south; infrequent or rare. August.

AMMOPHILA, Host.1244. *A. arundinacea*, Host. Sea Sand-Reed.

Calamagrostis arenaria, Roth.

Sandy soil along the lake shore, south; not rare. August.

DANTHONIA, D C.1245. *D. spicata*, Beauv. Wild Oat-Grass.

In Babcock's herbarium, credited to M. S. Bebb and labeled "Near Chicago." (B.)

PHRAGMITES, Trin.1246. *P. communis*, Trin. Reed.

Sloughs, south and southeast; frequent or common, elsewhere less common.

KOELERIA, Pers.1247. *K. cristata*, Pers.

Dry banks and fields; frequent or common. July.

EATONIA, Raf. Eatonia.1248. *E. obtusata*, Gray.

Frequent on dry prairies from Englewood, south. June—July. (B.)

1249. *E. pennsylvanica*, Gray.

Moist and open woods and fields; frequent. June—July. (B.)

ERAGROSTIS, Beauv. *Eragrostis*.1250. *E. reptans*, Nees.

Streams of the Calumet Region; infrequent.

Along the Desplaines river; rare, *Babcock*. August.1251. *E. MINOR*, Host.*E. poaeoides*, Beauv.

Sandy, waste grounds; infrequent. July—August. (B. P.)

Englewood, *Hill*.1252. *E. MAJOR*, Host.*E. poaeoides*, Beauv., var. *megastachya*, Gray.

In sandy soil and waste places; common. June 25th—August.

1253. *E. PILOSA*, Beauv.Dry sandy fields, Tolleston, Ind., August, 1886; abundant in this locality, *Hill*. Along railroads, *Babcock*.1254. *E. FRANKII*, Meyer. Frank's *Eragrostis*.Hyde Park. Low sandy banks near Sheffield, Ind., 1884. Colehour, Ind., 1889. Along railroads, *Babcock*.1255. *E. TENUIS*, Gray.Cheltenham Beach; rare, 1884. Roseland, *Brennan*. South Chicago, *University of Chicago Herb*. August. (B.)1256. *E. pectinacea*, Gray.Englewood, in sandy soil; infrequent, July, *Hill*. (B.)**DIARRHENA**, Raf.1257. *D. americana*, Beauv. *Diarrhena*.Woods near Graceland, *Babcock*.**DACTYLIS**, L.1258. *D. GLOMERATA*, L. Orchard Grass.

Door yards, shaded fields and banks; frequent. June—July.

POA, L. Meadow-Grass.1259. *P. ANNUA*, L. Low Spear-Grass.

Dry fields and waste places; abundant. May—October.

Sometimes biennial, Hammond, Ind., May 19th, 1888, *Hill*.1260. *P. COMPRESSA*, L. Wire-Grass.

Dry prairies; infrequent. July. (B.)

Near Garfield Park. Cheltenham Beach. Frequent from Englewood south, *Hill*.1261. *P. serotina*, Ehrh. False Red-top. Fowl Meadow-Grass.

Moist meadows; not common. July—September.

1262. *P. pratensis*, L. Green or Common Meadow-Grass. Kentucky Blue Grass. June Grass.
Meadows and dry banks; frequent. May—June, occasionally as late as September.
1263. *P. brevifolia*, Muhl.
Near Chicago, *Babcock's Collection*, credited to M. S. Bebb. (B.)
- GLYCERIA**, R.Br. Manna-Grass.
1264. *G. canadensis*, Trin. Rattlesnake-Grass.
Swamps and wet places; frequent or common. July—August.
1265. *G. nervata*, Trin. Fowl Meadow-Grass.
Wet prairies, fields and swamps; common. June—July. (B.)
1266. *G. fluitans*, R.Br.
Swamps and sloughs; frequent. June—July 25th.
- FESTUCA**, L. Fescue-Grass.
1267. *F. tenella*, Willd.
Sandy dry soil. June. (B.)
Englewood, south and east.
Abundant where found, as at Englewood from 65th St., south; about Hegewisch, Ind.; Hammond road from Whiting to East Chicago, *Hill*!
Delights to grow along roadsides and paths of low sandy ridges, *Hill*.
1268. *F. ovina*, L.
The only locality where I have found this species is near the ice-house, about a mile east of Hammond, Ind., on the dry banks of the Calumet river. The locality is evidently an old Indian resort, as attested by chips and arrow-heads of flint, teeth and bones of animals, and shells of mollusks, common northward. The species is not indigenous here. I have found it indigenous in cavities of rocks on the shores of Lake Superior, as at Marquette, Mich. Any little cup-shaped hollow where a handful of soil could gather, furnished a foothold for a small tuft of the grass, where it had for a companion, growing under the same conditions, another mountain grass, 8 to 8 inches high, *Trisetum subspicatum*, Beauv. *Hill*. (B. P.)
1269. *F. nutans*, Willd. Nodding Fescue-Grass.
Jackson Park. Woods near Stony Island. Woods near north end of Lake Calumet, 1886. Woods at Maywood, *Babcock*. July.
1270. *F. elatior*, L. Taller or Meadow Fescue.
Woods at Maywood, *Babcock*. Riverside, C. P. Murray.

BROMUS, L. Wild Oat.**1271. B. kalmii, Gray.**

Dry banks along railroads and roadsides; infrequent. June—July.

1272. B. SECALINUS, L. Cheat or Oat.

Dry banks and old fields, also in grain fields; infrequent. June—July.

1273. B. ciliatus, L.

Moist banks, open woods, etc.; frequent. July—August 25th.

1274. B. ciliatus, L., var. purgans, Gray.

With the type; rare. July. (B. P.)

LOLIUM, L.**1275. L. PERENNE, L. Common Darnel. Ray-Grass.**

In cultivated ground near Chicago, *Bastin*. Rare. (B. P.)

AGROPYRUM, Gaertn.**1276. A. REPENS, Beauv. Couch, Quitch, or Quick-Grass. False Wheat.**

Triticum repens, L.

In fields and cultivated grounds; common or abundant. June—August.

It can hardly be considered sufficiently abundant to be troublesome within our limits.

This is an introduced plant for the states of our latitude and eastward, where it always occurs in cultivated fields and pastures. It is said to be native on the western plains and Rocky Mountains. This troublesome weed comes to us from Europe. I believe it is also native along the northern lakes. In 1878, I found it on sand hills in the woods near Petoskey, Mich., growing with *A. dasystachyum*, Vasey, without any appearance of its troublesome habit. One seemed as much native as the other. In the summer of 1889, I found it on the shore of Lake Superior, north of Marquette, Mich. Here it grew among the willows and bushes on the sand ridge that forms the shore, in company with *Calamagrostis longifolia* Hook., and *Panicum virgatum, L.*, evidently as much native as they. It was taller than the form in our fields, 3 to 4 feet high. There were no cultivated fields near, as it was cut off from them by a wide stretch of forest and swamp. The specimens from Petoskey were evidently *Var. nemorale*, Anderson, but those from Marquette were typical. The roots were creeping, but not so extensively as in cultivated soil, *Hill*.

1277. *A. violaceum*, Lange.*Triticum violaceum*, Hornemann.

Sandy, open woods, south of Whiting, Ind., near Lake George; rare.
 July, 1881, *Hill*. (B. P.)

Glumes 5 to 7 nerved. A northern or mountain species, seemingly quite out of its range. In August, 1888, I found the same species at Ha! Ha! Bay on the Sagueney river, Canada. It is credited to the mountains of Pennsylvania to the White Mountains, and according to Lapham, Wisconsin and northward, *Hill*.

1278. *A. caninum*, Roem. & Schultes. Wheat-Grass.*Triticum caninum*, L.

Introduced with grass seed into a lawn at 711 Warren Ave., Chicago.

Liable to be found in cultivated grounds.

Spontaneous on prairie near Garfield Park. (B.)

HORDEUM, Tourn.1279. *H. jubatum*, L. Squirrel-tail Grass.

Moist prairies and fields; common near the lake shore. June—July.

ELYMUS, L. Wild Rye.1280. *E. virginicus*, L.

Banks of the Desplaines and Calumet rivers; frequent. July—August.

1281. *E. canadensis*, L. Nodding Wild Rye.

Banks of streams and lakes; frequent, probably more common than the last.

1282. *E. canadensis*, L., var. *glaucifolius*, Gray.

Banks of the Desplaines river and other streams; frequent. August. (B.)

1283. *E. striatus*, Willd.

Woods at Riverside, *Babcock*.

ASPARELLA, Willd.1284. *A. hystrix*, Willd. Bottle-Brush Grass.*Gymnostichum hystrix*, Schreb.

Moist and rich woods and shaded banks; common. July—August.

CONIFERÆ.

PINUS, Tourn.

1285. *P. strobus*, L. White Pine.

Sandy regions, southeast; frequent. June. (B.)

It is said that previous to 1871 it was abundant in the neighborhood of Berry Lake, Ind., and was sawed into lumber, but during the fall of that year the whole area was burned over.

1286. *P. banksiana*, Lambert. Gray or Northern Scrub Pine. Bank's or Jack Pine.

Barren bluffs and sand dunes along the lake shore; rare, north of Chicago, frequent southeast.

NOTE.—*Pinus inops*, Ait., and *rigida*, Mill., have been introduced at Evanston, and one or two plants were growing in an old field near the same place until recently.

LARIX, Tourn.

1287. *L. americana*, Michx. American Tamarack or Larch. Black Larch.

Swamps in the extreme southeastern portion of our district. May. Miller's, Ind., and vicinity.

THUYA (Thuja), Tourn.

1288. *T. occidentalis*, L. American Arbor Vitæ. White Cedar.

Glencoe and vicinity; rare, *Babcock*! Pine Station, Ind., *Hill*. Berry Lake, Ind. May.

JUNIPERUS, L.

1289. *J. communis*, L. Common Juniper.

Evanston and northward; infrequent or rare. May. Sand hills, Pine Station, Ind.; rare.

1290. *J. sabina*, L., var. *procumbens*, Ph. Savin. Juniper.

A few specimens were found near Glencoe as recently as 1885, but have now disappeared from that locality. (B.)

Waukegan, Lake County, Ills.; abundant near lake shore, *Babcock*.

1291. *J. virginiana*, L. Red Cedar. Savin.

Sandy soil; frequent locally. April. (B.)

South Evanston. Miller's and Whiting, north to Berry Lake, Ind.

PART II.

CRYPTOGAMIA.

EQUISETACEÆ.

EQUISETUM, L. Horsetail-Rush.

1292. **E. arvense**, L. Common Horsetail.

Moist places, usually in sandy or gravelly soil; common, often abundant. April—June.

1293. **E. limosum**, L. Swamp Horsetail.

In wet places and shallow water; frequent, especially southward. June—July. (B.)

1294. **E. hyemale**, L. Scouring Rush. Shave-Grass.

Wet ground, chiefly in sandy soil; frequent from Whiting, Ind., southward, elsewhere infrequent. May—July. (B.)

1295. **E. lævigatum**, Braun.

Usually in wet *sandy soil*, southeast; infrequent or rare. June—July. (B.)

Miller's and Pine Station, Ind. South Chicago, *Brennan*.

1296. **E. variegatum**, Schleicher.

Wet sandy soil, usually along the borders of sloughs. July. (B.)
Miller's, Ind.; not rare. Pine Station and Edgemoor, Ind., *Hill*!

FILICES.

ADIANTUM, L.

1297. **A. pedatum**, L. Common or American Maidenhair.

Moist woods and shaded banks, in rich soil; frequent. July—August 15th.

PTERIS, L.

1298. **P. aquilina**, L. Common Brake. Eagle Fern. Bracken.

Open woods, banks and copses; frequent. July—August.

WOODWARDIA, Smith.

1299. **W. virginica**, Smith. Chain-Fern.

Bogs; frequent or common near Miller's, Ind. July. (P.)

ASPLENIUM, L. Spleenwort. Shield-Fern.1800. **A. ebeneum**, Ait.

In sandy soil; very rare. (B.)

Woods near Berry Lake, Ind. Miller's, Ind., *Bastin*.

1801. **A. thelypteroides**, Michx. Silvery Spleenwort.

Specimens have been exhibited from the northern portion of Cook County, near Glencoe. Berry Lake, Ind.; rare. July. (B.)

1802. **A. filix-fœmina**, Bernh. Lady-Fern.

Moist rich woods; infrequent or rare, except locally. July.

Niles. Near Stony Island. Maywood. Glencoe, *Babcock*! Riverside, *Herman Jaeger*.

PHEGopteris, Fee.1808. **P. hexagonoptera**, Fee.

Rich open woods and shaded ravines, chiefly in the northern portion of Cook County; infrequent. July—August 10th.

ASPIDIUM, Swartz.1804. **A. thelypteris**, Swartz. Marsh Shield-Fern.

Low grounds and marshes; common throughout the southern portion of our district, less frequent elsewhere. August.

1805. **A. spinulosum**, Swartz, var. **intermedium**, Eaton.

In damp rich woods, both north and south; common. July.

1806. **A. acrostichoides**, Swartz. Christmas Fern.

Woods and banks of ravines, north of Glencoe. Three or four specimens were found on a sand hill near Miller's, Ind., in 1886-'87. Not found in 1888. Rare. July. (B.)

CYSTopteris, Bernh.1807. **C. fragilis**, Bernh. Bottle Cystopteris. Bladder-Fern.

Shaded banks and rich woods; infrequent west and north. July.

ONOCLEA, L.1808. **O. sensibilis**, L. Sensitive Fern.

Moist or wet places, especially in marsh grass; common or abundant. June 15th—July 25th.

OSMUNDA, L.1809. **O. regalis**, L. Flowering Fern. Royal Fern.

Moist rich woods and swamps; frequent. May 15th—July.

1810. **O. claytoniana**, L. Clayton's Flowering Fern.

Wet woods, shaded banks and swamps; frequent east. May 15th—June 15th.

1811. *O. cinnamomea*, L. Cinnamon Fern.

Swamps and low places; common near the lake shore, especially southeast. May.

OPHIOGLOSSACEÆ.

- BOTRYCHIUM**, Swartz.

1812. *B. ternatum*, Swartz, var. *obliquum*, Milde.

B. lunarioides, var. *obliquum*, in Manual, 5th Ed.

Woods near Miller's, Ind., *Babcock!* Rare. August.

1818. *B. ternatum*, Swartz, var. *intermedium*, Watson.

B. lunarioides, in Manual, 5th Ed.

Woods near Miller's, Ind., *Hill!* August. (B. P.)

1814. *B. virginianum*, Swartz. Virginia Grape Fern.

Rich and rather open, moist woods; frequent. May 20th—June.

LYCOPODIACEÆ.

- LYCOPODIUM**, L. Club-Moss.

1815. *L. lucidulum*, Michx. Trailing Evergreen. Shining Club-Moss.

Damp pine woods; rare. August. (B.)

Chesterton, Ind., 1888, *Hill.* Pine Station, Ind., 1887. Miller's, Ind., 1889.

1816. *L. inundatum*, L. Marsh Club-Moss.

In sandy soil, damp woods and pine barrens; rare. July—August. (B. P.)

This species has been found for several seasons in the following localities: South Evanston; Miller's, Pine Station, Berry Lake, and Tolleston, Ind; not far from the lake shore, in each case.

1817. *L. obscurum*, L. Ground Pine.

L. dendroideum, Michx.

Woods, near Pine Station, Ind., 1889. Miller's, Ind., *Hill.* (B. P.)

1818. *L. complanatum*, L. Festoon Ground Pine.

Sandy soil; infrequent or rare. August—September. (B.)

North of Berry Lake, Ind. Miller's, Ind., *Hill!*

SELAGINELLACEÆ.

- SELAGINELLA**, Beauv. Dwarf Club-Moss.

1819. *S. rupestris*, Spring.

In sandy soil; infrequent. July—August 25th. (B.)

Pine Station, Ind. A few plants were found at Colehour, Ind., in 1886. Miller's, Ind., *Hill.*

1820. **S. apus**, Spring.

Shaded banks and sandy banks of sloughs; rare. August. (B.)

Evanston. Pine Station, Miller's, 1889, and Clarke, Ind. Windsor Park. Colehour, Ind., *Hill*.

ISOETES, L.1821. **I. melanopoda**, J. Gay. Quillwort.

Muddy borders of a pond near Hyde Park water works, 1885. Wet prairies near Grand Crossing, 1886-'87. (B.)

SALVINIACEÆ.**AZOLLA**, Lam.1822. **A. caroliniana**, Willd. Azolla.

In a pond near South Chicago, 1886.

During improvements made in this locality, the pond was filled.

So far as known, this is the only locality where this species has been found within our limits. (B.)

APPENDIX I.

ADDITIONS TO THE FLORA.

Page 6. *Hydrastis canadensis*, L.

Collected at Rose Hill; rare, *Johnson*.

Page 11. Insert after *NASTURTIUM OFFICINALE*, R. Br.,—

N. SYLVESTRE, R. Br. Yellow Cress.

Banks of Salt Creek, near Western Springs. Local, *Hill*! (B.)

Page 16. Insert after *Viola blanda*, Willd.,—

V. PRIMULÆFOLIA, L. Primrose-leaved Violet.

In woods near Gardner's Park, Kensington; local, *Brennan*. (B. P.)

Page 23. *Flørkea proserpinacoides*, Willd.

Woods on the hills near Beverly Hill Station; abundant, 1891, *Hill*.

Page 35. Insert after *Geum strictum*, Ait.,—

G. vernum, T. & G. *Avens*.

Beverly Hills, frequent, *Hill*. (B.)

Page 36. *Potentilla palustris*, Scop.

Specimens from near 88rd St. and Egondale Ave. have from 5 to 7 sepals and petals, and as many bractlets at each sinus; leaflets 3 to 7; June 15th, 1891, *M. A. Miner*!

Page 36. *Rosa setigera*, Michx.

Climbing or Prairie Rose.

Willow Springs, *Hill*.

Page 41. Insert after *Didiplis linearis*, Raf.,—

Rotala ramosior, Koehne.

Near Evanston; rare, *Johnson*. (B.)

Page 41. Insert after *Decodon verticillatus*, Ell.,—

CUPHEA VISCOSISSIMA, Jacq. Clammy Cuphea.

Prairies, North Evanston; local, *Johnson*! (B.)

Page 45. *Chærophylllum procumbens*, Crantz.

Riverdale on the banks of the Calumet river; abundant in 1891, *Hill*!

Page 47. Insert after *Cornus sericea*, L.,—

C. baileyi, Coult. & Evans. (Botanical Gazette, vol. xv, p. 87.)

Common on sand ridges along the lake shore. (B. P.)

"Erect shrub, with reddish-brown, mostly smooth branches; branchlets and inflorescence, pubescent to wooly; petioles 6 to 25 mm. long; leaves from lanceolate to ovate, acute or short acuminate, acute or obtuse at base, appressed-pubescent to glabrate above, white beneath and with wooly hairs variously intermingled with appressed ones (or in some cases all appressed), 2.5 to 12 cm. long, 1.2 to 7.5 cm. wide; flowers in small rather compact cymes; calyx teeth from small to prominent; fruit white; stone decidedly compressed, flat-topped, rarely oblique, with a very prominently furrowed edge, much broader than high (8 mm. high, 4 to 6 mm. broad).

It differs from *C. asperifolia* in its mostly glabrate upper leaf surface, white lower leaf surface, and much compressed deeply furrowed stone, which is much broader than high. It differs from *C. stolonifera*, with which it has been mostly confused in herbaria, not only in the woolliness of the lower leaf surface, but very strikingly in the stone characters just enumerated. It resembles *C. sericea* so little that a statement of the differences would be a repetition of all the specific characters." *Coulter & Evans, Botanical Gazette as cited.*

Page 59. Insert after *Aster ptarmicoides*, T. & G.,—

A. angustus, T. & G.

Near the Town of Lake High School; common, *J. E. Armstrong*. (B.)

Page 68. *Cacalia suaveolens*, L.

Thickets west of Porter's, Ind., on the east side of the Calumet river, at the crossing of the M. S. & L. S. R. R.; rare, *Hill*.

Page 69. Insert in place of *Cnicus undulatus*, Gray.,—

C. hillii, W. M. Canby (Garden and Forest, March 4th, 1891).

Prof. E. J. Hill, in honor of whom the species is named, furnishes us with the following description:

General appearance much like that of *C. pumilus*, Torr., but the whole plant is smaller and more simple in habit, 15 to 20 inches high; heads large, rarely more than one, naked or with 1 to 8 narrow involucre leaves; root perpendicular, simple, very slender for 2 to 6 inches below the crown, then enlarging, hollow and fusiform, about 8 to 10 inches long; leaves smaller and less divided than in *C. pumilus*, often, especially the younger ones, nearly undulate; scales of the involucre with a dark glutinous line on the

back; pappus usually slender-pointed, but occasionally a few with narrow-spatulate tips; anthers more or less acuminate. Flowers several weeks earlier than *C. pumilus*, its season being from about June 20th to August 1st. Dry sands from Whiting, Ind., eastward near the lake shore. First observed, July 9th, 1890. Collected at Kankakee, Ill., 1870, *E. J. Hill*. Athens, Ill., *Elihu Hall*. Ames, Ia., *A. S. Hitchcock*.

It probably takes the place of *C. pumilus* in the west, and the region of the Great Lakes. (B. P.)

Page 94. Insert after *LEONURUS CARDIACA*, L.,—

L. SIBIRICUS, L.

Grand Boulevard, *Bastin*. (B.)

Page 98. *SALSOLA KALI*, L.

C. P. & Ft. W. R. R., near Clarke, Ind.; also on side track to ice house near Wolf Lake, within the limits of Chicago, *Hill*.

Page 106. Insert after *Quercus bicolor*, Willd.,—

Q. muhlenbergii, Engelm.

Rare and local; west side Wolf Lake, near the north end, in Lake County, Ind., *Hill*!

Page 106. Insert after *Quercus imbricaria*, Michx.,—

Q. imbricaria × *tinctoria*.

Groves along Flag Creek, about one mile northwest of Willow Springs.

Some of the leaves were almost like those of *Q. imbricaria*, but the larger number were lobed, but less deeply than in typical *tinctoria*; leaves slightly pubescent on the underside. All acorns gathered from this form were either typical fruits of *imbricaria*, or of *Q. tinctoria*, but with pubescent, yellowish, squarrose scales. *Q. macrocarpa* was the only other species found in the immediate vicinity, *Hill*!

Page 118. Insert after *Tradescantia virginica*, L.,—

T. virginica, L., var. *villosa*, Watson.

In woods near Washington Heights, June, 1891, *Bastin*. (B.)

Page 122. *Potamogeton pulcher*, Tuck.

Collected in a railroad ditch near Dune Park, Ind.; rare, 1891.

Page 122. Insert after *Potamogeton amplifolius*, Tuck.,—

P. illinoensis, Morong.

Leaves generally not very large, smaller, on the whole, than those of *P. amplifolius*; stipules blunt. Lake Calumet, in water 2 feet or more deep, at Pullman, August 27th, 1890, *Hill*. (B.)

Page 127. Insert before *Eleocharis capitata*, R. Br.,—

E. quadrangulata, R.Br.

Wolf Lake, near 121st St.; rare, though abundant in this locality,
Hill (B.)

Page 128. *Scirpus debilis*, Ph.

Persistent forms bearing two stamens are frequent at Dune Park
and Miller's, Ind.

Page 129. *Hemicarpha subsquarrosa*, Nees.

Typical specimens are found in the wet sands along the railroad
from Miller's to Dune Park, Ind.; frequent, *Hill*!

Page 133. Insert after *Carex crinita*, Lam.,—

C. virescens, Muhl.

Woods, in gravelly soil, near Sharpshooter's Park in Gano; common
and local, *Hill*. (B.)

APPENDIX II.

ANALYSIS OF FAMILIES.

Families.	Genera.	Native Species.	Native Varieties.	Introduced Species.	Introduced Varieties.
Ranunculaceæ	14	29	5	4	
Magnoliaceæ	1	1			
Menispermaceæ	1	1			
Berberidaceæ	2	2			
Nymphaeaceæ	4	5	1		
Sarraceniacæ	1	1			
Papaveraceæ	2	2			
Fumariaceæ	4	4		2	
Cruciferae	12	18	2	14	
Capparidaceæ	2	1		1	
Cistaceæ	3	6	1		
Violaceæ	1	11	2	2	
Caryophyllaceæ	7	12		11	
Portulacaceæ	3	3		1	
Hypericaceæ	2	9	1	1	
Malvaceæ	4	3		5	
Tiliaceæ	1	1			
Linaceæ	1	2		1	
Geraniaceæ	4	6	1		
Rutaceæ	2	2			
Illiciæ	2	2		1	
Celastraceæ	2	3	1		
Ramnacæ	2	3			
Vitaceæ	2	4			
Sapindaceæ	3	6			
Anacardiaceæ	1	6			
Polygalaceæ	1	7			
Leguminosæ	22	44	2	9	
Rosaceæ	12	42	5	2	
Saxifragaceæ	5	10		1	
Crassulaceæ	2	1		2	
Droseraceæ	1	1	1		
Hamamelidæ	1	1			
Haloragæ	4	6			
Melastomaceæ	1	1			
Lythraceæ	3	3			
Onagraceæ	5	14	2	1	
Curcubitaceæ	2	2			
Cactaceæ	1	1			
Ficoideæ	1			1	
Umbelliferae	21	20	3	4	
Araliaceæ	1	4			
Cornaceæ	2	8			
Caprifoliaceæ	6	14		1	
Rubiaceæ	4	11	3		
Valerianaceæ	2	2		1	
Dipsaceæ	1			1	
Compositæ	51	144	18	26	1

Families.	Genera.	Native Species.	Native Varieties.	Introduced Species.	Introduced Varieties.
Lobellaceæ.....	1	6			
Campanulaceæ.....	2	3	1		
Ericaceæ.....	9	16	4	1	
Primulaceæ.....	5	8	2	1	
Oleaceæ.....	1	4			
Apocynaceæ.....	1	2			
Asclepiadaceæ.....	2	12	1		
Gentianaceæ.....	4	10			
Polemoniaceæ.....	2	7			
Hydrophyllaceæ.....	2	4			
Borraginaceæ.....	6	9	1	3	
Convolvulaceæ.....	3	5	2	3	
Solanaceæ.....	4	4		5	1
Scrophulariaceæ.....	16	27		6	
Orobanchaceæ.....	2	3			
Lentibulaceæ.....	1	6			
Blignoniaceæ.....	2			2	
Acanthaceæ.....	1	1			
Verbenaceæ.....	3	7			
Labiataæ.....	20	22	1	11	
Plantaginaceæ.....	1	4		1	
Nyctaginaceæ.....	1	1			
Illecebraceæ.....	1	2			
Amarantaceæ.....	2	2		2	
Chenopodiaceæ.....	5	4	1	6	
Phytolacaceæ.....	1	1			
Polygonaceæ.....	4	16	2	8	
Podostemaceæ.....	1	1			
Aristolochiaceæ.....	1	1			
Piperaceæ.....	1	1			
Lauraceæ.....	2	2			
Elæagnaceæ.....	1	1			
Santalaceæ.....	1	1			
Euphorbiaceæ.....	2	6		1	
Urticaceæ.....	10	10		2	
Juglandaceæ.....	2	5			
Myricaceæ.....	1	1		1	
Oupullifereæ.....	7	19			
Salicaceæ.....	2	17	4	2	1
Ceratophyllaceæ.....	1	1			
Hydrocharidaceæ.....	2	2			
Orchidaceæ.....	11	28	1		
Hæmodoraceæ.....	1	1			
Iridaceæ.....	2	3			
Amaryllidaceæ.....	1	1			
Dioscoreaceæ.....	1	1			
Liliaceæ.....	14	28		1	
Pontederiaceæ.....	2	2			
Xyridaceæ.....	1	1			
Commelinaceæ.....	2	2			
Juncaceæ.....	2	10	5	1	
Typhaceæ.....	2	5			
Araceæ.....	4	5			
Lemnaceæ.....	3	5			
Alismaceæ.....	2	4	2		
Naladaceæ.....	5	17	2		
Cyperaceæ.....	11	93	20	3	
Gramineæ.....	37	60	3	25	2

Families.	Genera.	Native Species.	Native Varieties.	Introduced Species.	Introduced Varieties.
Coniferae.....	4	6	1		
Equisetaceæ.....	1	5			
Filices.....	9	14	1		
Ophioglossaceæ.....	1	1	2		
Lycopodiaceæ.....	1	4			
Selaginellaceæ.....	2	3			
Salviniaçæ.....	1	1			

ADDITIONS FROM APPENDIX I.

Cruciferae.....				1	
Violaceæ.....				1	
Rosaceæ.....		1			
Lythraceæ.....	2	1		1	
Compositæ.....		1			
Cornaceæ.....		1			
Labiata.....				1	
Cupulliferae.....		2*			
Commelinaceæ.....			1		
Naiadaceæ.....		1			
Cyperaceæ.....		2			
Final totals, 113.....	490	1042	108	181	5

*One hybrid.

INDEX OF FAMILIES AND GENERA.

SYNONYMS IN ITALICS.

	PAGE.		PAGE.
Abutilon	22	<i>Anemone</i>	2
Acalypha	102	Anemonella	2, 5
Acanthaceæ	90	Angelica	43
Acer	25	Antennaria	60, 89
Acerates	79	<i>Antennaria</i>	60
Achillea	66	Anthemis	66
Acnida	96	Anychia	96
Acorus	120	Aphyllon	89
Actæa	6	Aplos	32
Actinomeris	65	Aplectrum	110
<i>Actinomeris</i>	65	Apocynaceæ	78
Adiantum	149	Apocynum	78
Adlumia	8	Aquilegia	5
Agrimonia	36	Arabis	10
Agropyrum	146	Araceæ	120
<i>Agrostemma</i>	18	Aralia	46
Agrostis	142	Arallaceæ	46
Aletris	113	<i>Archangelica</i>	43
Allsma	121	<i>Archemora</i>	44
Alliaceæ	121	Arctium	68
Allium	115	Arctostaphylos	75
Alnus	105	Arenaria	18
Alopecurus	142	Arethusa	111
<i>Alpine</i>	18	Argemone	8
Alyssum	11	Arisæma	120
Amarantaceæ	96	Aristida	141
Amarantus	96	Aristolochiaceæ	101
Amaryllidaceæ	114	Artemisia	67, 89
Ambrosia	61	Asarum	101
Amelanchier	38	Asclepiadaceæ	78
<i>Ammannia</i>	41	Asclepias	78
Ammophila	143	Asparagus	115
<i>Ammophila</i>	143	Aspidium	150
Amorpha	29	Asplenium	150
Ampelopsis	25	Asprella	147
Amphicarpæa	32	Aster	56, 84, 154
Anacardiaceæ	26	Astragalus	29
<i>Anacharis</i>	110	Atriplex	97
Anaphalis	60	<i>Asalea</i>	75
Andropogon	140	Azolla	152
Anemone	1, 3		

PAGE.	PAGE.
Babtiſia..... 28	Ceanothus..... 25
Bartonia..... 80	Celaſtracæ..... 24
Berberidacæ..... 6	Celaſtrus..... 24
Berula..... 45	Celtis..... 103
Betula..... 104	Centaurea..... 69
Bidens..... 65	Cenchrus..... 140
Bignoniacæ..... 90	Cephalanthus..... 50
Blephilia..... 93	Cerastium..... 19
Bœhmeria..... 103	Ceratophyllacæ..... 110
Boltonia..... 56	Ceratophyllum..... 110
Borraginacæ..... 82	Chærophyllyum..... 45, 153
Botrychium..... 151	Chelone..... 86
Brachyelytrum..... 142	Chenopodiaceæ..... 96
Brasenia..... 7	Chenopodium..... 97
Brassica..... 12	Chimaphila..... 75
Bromus..... 146	Chrysanthemum..... 67
Brunella..... 94	Chrysopogon..... 141
Buchnera..... 88	Cichorium..... 70
	Cicuta..... 45
Cacalia..... 68, 154	Cimicifuga..... 6
Cactacæ..... 43	Cinna..... 143
Cakile..... 12	Circeæ..... 43
Calamagrostis..... 143, 146	Cirsium..... 68
Calamagrostis..... 143	Cistacæ..... 13
Calamintha..... 92	Cladium..... 130
Callirrhœ..... 22	Claytonia..... 20
Callitriche..... 40	Clematis..... 1
Calopogon..... 111	Cleome..... 12
Caltha..... 5	Cnicus..... 68, 154
Calystegia..... 83, 84	Collinsia..... 86
Camassia..... 115	Collinsonia..... 91
Camellina..... 11	Comandra..... 101
Campanula..... 72	Commelina..... 117
Campanulacæ..... 72	Commelinacæ..... 117
Cannabis..... 103	Compositæ..... 52
Capparidacæ..... 12	Comptonia..... 104
Caprifoliacæ..... 48	Coniferæ..... 148
Capsella..... 12	Conium..... 45
Cardamine..... 9	Conopholis..... 89
Carex..... 130, 156	Convolvulacæ..... 83
Carpinus..... 105	Convolvulus..... 83
Carum..... 45	Coptis..... 5
Carya..... 104	Corallorrhiza..... 110
Caryophyllacæ..... 17	Coreopsis..... 65
Cassandra..... 75	Corispermum..... 97
Cassia..... 32	Cornacæ..... 47
Castalia..... 7	Cornus..... 47, 154
Castelleja..... 89	Corydalis..... 9
Catalpa..... 90	Corylus..... 105
Caulophyllum..... 6	Crassulacæ..... 39

	PAGE.		PAGE.
<i>Cratægus</i>	37	<i>Elodea</i>	110
<i>Cruciferae</i>	9	<i>Elodes</i>	21
<i>Cryptotaenia</i>	44	<i>Elymus</i>	147
<i>Cucurbitaceæ</i>	43	<i>Epigæa</i>	75
<i>Cuphea</i>	153	<i>Epilopium</i>	41
<i>Cupuliferae</i>	104	<i>Equisetaceæ</i>	149
<i>Cuscuta</i>	84	<i>Equisetum</i>	149
<i>Cycloloma</i>	96	<i>Eragrostis</i>	144
<i>Cynoglossum</i>	82	<i>Erechtites</i>	68
<i>Cynoglossum</i>	82	<i>Ericaceæ</i>	73
<i>Cynthia</i>	69	<i>Erigenia</i>	46
<i>Cyperaceæ</i>	125	<i>Erigeron</i>	60
<i>Cyperus</i>	125	<i>Eriophorum</i>	129
<i>Cypripedium</i>	113	<i>Eryngium</i>	46
<i>Cystopteris</i>	150	<i>Erythronium</i>	116
<i>Dactylis</i>	144	<i>Eschscholtzia</i>	8
<i>Danthonia</i>	143	<i>Eulophus</i>	44
<i>Datura</i>	85	<i>Euonymus</i>	24
<i>Daucus</i>	43	<i>Eupatorium</i>	52
<i>Decodon</i>	41	<i>Euphorbia</i>	84, 102
<i>Delphinium</i>	6	<i>Euphorbiaceæ</i>	102
<i>Dentaria</i>	9	<i>Euzolus</i>	96
<i>Desmodium</i>	30	<i>Fagopyrum</i>	100
<i>Deyeuzia</i>	143	<i>Fagus</i>	106
<i>Diarrhena</i>	144	<i>Fedia</i>	52
<i>Dicentra</i>	8	<i>Festuca</i>	145
<i>Didiplis</i>	41	<i>Ficoideæ</i>	43
<i>Diervilla</i>	50	<i>Filices</i>	149
<i>Dioscorea</i>	114	<i>Fimbristyllis</i>	128
<i>Dioscoreaceæ</i>	114	<i>Florkea</i>	23, 153
<i>Diplopappus</i>	59	<i>Fragaria</i>	35, 84
<i>Dipsaceæ</i>	52	<i>Fraxinus</i>	77
<i>Dipsacus</i>	52	<i>Fumaria</i>	9
<i>Dodecatheon</i>	76	<i>Fumariaceæ</i>	8
<i>Draba</i>	10	<i>Galeopsis</i>	94
<i>Dracocephalum</i>	93	<i>Galinsoga</i>	66
<i>Drosera</i>	27, 39	<i>Galium</i>	50
<i>Droseraceæ</i>	39	<i>Gaultheria</i>	75
<i>Dulichium</i>	126	<i>Gaura</i>	42
<i>Dysodia</i>	66	<i>Gaylussacia</i>	14, 73
<i>Eatonia</i>	143	<i>Gentiana</i>	79
<i>Echinacea</i>	66	<i>Gentianaceæ</i>	79
<i>Echinocystis</i>	43	<i>Geraniaceæ</i>	22
<i>Echinosperrum</i>	82	<i>Geranium</i>	22
<i>Eclipta</i>	62	<i>Gerardia</i>	88
<i>Elæagnaceæ</i>	101	<i>Geum</i>	35, 153
<i>Eleocharis</i>	127, 156	<i>Gleditschia</i>	33
<i>Ellisia</i>	82	<i>Glyceria</i>	145

PAGE.	PAGE.
Gnaphalium..... 61	Isanthus..... 91
Goodyera..... 111	Isoetes..... 152
Gramineæ..... 138	Isopyrum..... 5
Gratiola..... 87	Juglandaceæ..... 104
Grindella..... 53	Juglans..... 104
Gymnocladus..... 32	Juncaceæ..... 118
Gymnostichum..... 147	Juncus..... 118
Habenaria..... 111	Juniperus..... 148
Hæmodoraceæ..... 113	Kœleria..... 143
Haloragææ..... 40	Krigia..... 69
Hamamelidææ..... 40	Kuhnia..... 53
Hamamelis..... 40	Labiataæ..... 91
Hedeoma..... 92	Lactuca..... 71
Helenium..... 66	Laportea..... 103
Hellanthemum..... 13	Lappa..... 68
Hellanthus..... 63, 84	Larix..... 148
Heliopsis..... 62	Lathyrus..... 31, 98
Hemicarpha..... 129, 156	Lauraceæ..... 101
Hepatica..... 2	Lechea..... 13
Heracleum..... 44	Leersia..... 140
Heteranthera..... 117	Leguminosæ..... 28
Heuchera..... 38	Lemna..... 120
Hibiscus..... 22	Lemna..... 120
Hicoria..... 104	Lemnaceæ..... 120
Hieracium..... 70	Lentibulaceæ..... 90
Hierochloa..... 141	Leonurus..... 94, 155
Hippuris..... 40	Lepachys..... 63
Hordeum..... 147	Lepidium..... 12
Houstonia..... 50	Lespedeza..... 30
Hudsonia..... 13	Leucanthemum..... 67
Humulus..... 103	Liatris..... 53
Hydrastis..... 6, 153	Lillaceæ..... 114
Hydrocharidaceæ..... 110	Lilium..... 116
Hydrocotyle..... 46	Linaceæ..... 22
Hydrophyllaceæ..... 81	Linaria..... 86
Hydrophyllum..... 81	Lindera..... 101
Hypericaceæ..... 20	Linnæa..... 49
Hypericum..... 20	Linum..... 22
Hypoxis..... 114	Liparis..... 110
Ilex..... 24	Lippia..... 91
Illiciææ..... 24	Liriodendron..... 6
Illecebraceæ..... 96	Lithospermum..... 82
Ilysanthes..... 87	Lobelia..... 72
Impatiens..... 23	Lobellaceæ..... 72
Inula..... 61	Lolium..... 146
Ipomœa..... 83	Lonicera..... 49
Iridaceæ..... 114	Lophanthus..... 93
Iris..... 114	Ludwigia..... 41

	PAGE.		PAGE.
Lupinus.....	28	<i>Nelumbium</i>	7
Luzula.....	119	Nelumbo.....	7
Lychnis.....	18	Nemopanthes.....	24
Lycopodiaceæ.....	151	Nepeta.....	93
Lycopodium.....	27, 39, 151	<i>Nesaea</i>	41
Lycopus.....	92	Nicotiana.....	85
Lysimachia.....	77	<i>Nuphar</i>	7
<i>Lysimachia</i>	76, 77	Nyctaginaceæ.....	95
Lythraceæ.....	41	Nymphæa.....	7
Lythrum.....	41	<i>Nymphæa</i>	7
		Nymphæaceæ.....	7
Magnoliaceæ.....	6	Nyssa.....	48, 80
Malanthemum.....	115		
Malva.....	21	Oakesia.....	116
Malvaceæ.....	21	Oenothera.....	42
Marrubium.....	94	Oleaceæ.....	77
<i>Maruta</i>	66	Onagraceæ.....	41
<i>Matricaria</i>	69	Onoclea.....	150
Medeola.....	116	Onosmodium.....	83
Medicago.....	29	Ophloglossaceæ.....	151
Melampyrum.....	89	Opuntia.....	43
Melastomaceæ.....	40	Orchidaceæ.....	110
Melilotus.....	28	Orchis.....	111
Menispermaceæ.....	6	Orobanchaceæ.....	89
Menispermum.....	6	Osmorrhiza.....	45
Mentha.....	92	Osmunda.....	150
Menyanthes.....	80	Ostrya.....	105
Mertensia.....	82	Oxalis.....	23
Mimulus.....	87	Oxybaphus.....	95
Mitchella.....	50		
Mitella.....	38	<i>Panax</i>	46, 47
Mollugo.....	43	Panicum.....	139, 146
Monarda.....	93	Papaver.....	8
Monotropa.....	76	Papaveraceæ.....	8
<i>Montelia</i>	96	Parietaria.....	103
Morus.....	103	Parnassia.....	38
Muhlenbergia.....	141	Parthenium.....	61
<i>Mulgedium</i>	71	Pastinaca.....	44
Myosotis.....	82	Pedicularis.....	89
Myosurus.....	3	Peltandra.....	120
Myrica.....	104	Penthorum.....	39
Myricaceæ.....	104	Pentstemon.....	86
Myriophyllum.....	40	Petalostemon.....	29
		Phalaris.....	141
<i>Nabalus</i>	70, 71	Phaseolus.....	32
Naiadaceæ.....	121	<i>Phaseolus</i>	32
Najas.....	125	Phegopteris.....	150
Nasturtium.....	11, 153	Phleum.....	142
<i>Naumburgia</i>	77	Phlox.....	80
Negundo.....	26	Phragmites.....	143

	PAGE.
Phryma.....	91
Physalis.....	85
Physocarpus.....	34
Physostegia.....	94
Phytolacca.....	98
Phytolaccaceæ.....	98
Pilea.....	103
Pimpinella.....	44
Pinus.....	20, 148
Piperaceæ.....	101
Pirus.....	14, 37
Plantaginaceæ.....	94
Plantago.....	94
Pluchea.....	60
Poa.....	144
Podophyllum.....	7
Podostemaceæ.....	100
Podostemon.....	100
Pogonia.....	111
Polanisia.....	12, 98
Polemoniaceæ.....	80
Polemonium.....	81
Polygala.....	27
Polygalaceæ.....	27
Polygonaceæ.....	98
Polygonatum.....	115
Polygonella.....	100
Polygonum.....	84, 99
<i>Polygonum</i>	100
Polymnia.....	61
Polytænia.....	44
Pontederia.....	117
Pontederiaceæ.....	117
Populus.....	109
Portulaca.....	19
Portulacaceæ.....	19
Potamogeton.....	122, 155
Potentilla.....	35, 153
Prenanthes.....	70
Primulaceæ.....	76
<i>Prinos</i>	24
Proserpinaca.....	40
Prunus.....	33
Psoralea.....	29
Ptelea.....	24
Pteris.....	149
<i>Pulsatilla</i>	1
Pycnanthemum.....	92
Pyrola.....	75
Pyrus.....	37

	PAGE.
<i>Quamoclit</i>	83
Quercus.....	105, 155
Ranunculaceæ.....	1
Ranunculus.....	3, 23, 66
Rhamnaceæ.....	25
Rhamnus.....	25
Rhexia.....	40
Rhododendron.....	75
Rhus.....	26
Rhynchospora.....	129
Ribes.....	39
Robinia.....	29
Rosa.....	36, 153
Rosaceæ.....	33
Rotala.....	153
Rubiaceæ.....	50
Rubus.....	34
Rudbeckia.....	63
Ruellia.....	90
Rumex.....	98
Rutaceæ.....	23
Sabbatia.....	79
Sagittaria.....	121
Salicaceæ.....	107
Salix.....	107
Salsola.....	98, 155
Salviniaceæ.....	152
Sambucus.....	48
Samolus.....	77
Sanguinaria.....	8
Sanicula.....	46
Santalaceæ.....	101
Sapindaceæ.....	25
Saponaria.....	17
Sarracenia.....	8
Sarraceniaceæ.....	8
Sassafras.....	101
Saururus.....	101
Saxifraga.....	38
Saxifragaceæ.....	38
Scheuchzeria.....	122
Schollera.....	117
Scilla.....	115
Scirpus.....	125, 128, 156
<i>Scirpus</i>	129
Scleria.....	130
Scrophularia.....	86
Scrophulariaceæ.....	85

	PAGE.		PAGE.
<i>Scutellaria</i>	94	<i>Thalictrum</i>	2
<i>Sedum</i>	39	<i>Thaspium</i>	44
<i>Selaginella</i>	151	<i>Thuja</i>	148
<i>Selaginellaceæ</i>	151	<i>Thuya</i>	148
<i>Senecio</i>	67	<i>Tiedemannia</i>	44
<i>Setaria</i>	140	<i>Tilia</i>	22
<i>Seymeria</i>	88	<i>Tiliacæ</i>	22
<i>Shepherdia</i>	101	<i>Tofieldia</i>	117
<i>Sicyos</i>	43	<i>Tradescantia</i>	118, 155
<i>Silene</i>	17	<i>Tragopogon</i>	70
<i>Silphium</i>	61	<i>Tridentalis</i>	76
<i>Sinapis</i>	12	<i>Trifolium</i>	28
<i>Sisymbrium</i>	11	<i>Triglochin</i>	121
<i>Sisyrinchium</i>	114	<i>Trillium</i>	116
<i>Slum</i>	45	<i>Triosteum</i>	49
<i>Sium</i>	45	<i>Trisetum</i>	145
<i>Smilacina</i>	115	<i>Triticum</i>	146, 147
<i>Smilacina</i>	115	<i>Trychostylis</i>	128
<i>Smilax</i>	114	<i>Turritis</i>	10
<i>Solanaceæ</i>	84	<i>Typha</i>	119
<i>Solanum</i>	84	<i>Typhaceæ</i>	119
<i>Solidago</i>	53, 59, 84		
<i>Sonchus</i>	71	<i>Ulmus</i>	102
<i>Sorghum</i>	141	<i>Umbelliferae</i>	43
<i>Sparganium</i>	119	<i>Urtica</i>	103
<i>Spartina</i>	138	<i>Urticacæ</i>	102
<i>Specularia</i>	72	<i>Utricularia</i>	90
<i>Spergula</i>	19	<i>Uvularia</i>	116
<i>Spiræa</i>	34	<i>Uvularia</i>	116
<i>Spiræa</i>	34		
<i>Spiranthes</i>	111	<i>Vaccaria</i>	17
<i>Spirodela</i>	120	<i>Vaccinium</i>	14, 73
<i>Sporobolus</i>	142	<i>Valeriana</i>	51
<i>Stachys</i>	94, 125	<i>Valerianacæ</i>	51
<i>Staphylea</i>	26	<i>Valerianella</i>	52
<i>Steironema</i>	76	<i>Vallisneria</i>	110
<i>Stellaria</i>	19	<i>Verbascum</i>	85
<i>Stipa</i>	141	<i>Verbena</i>	91
<i>Strophostyles</i>	32	<i>Verbenacæ</i>	91
<i>Stylophorum</i>	8	<i>Verbesina</i>	65
<i>Symplocarpus</i>	120	<i>Vernonia</i>	52
		<i>Veronica</i>	87
<i>Talinum</i>	20	<i>Viburnum</i>	48
<i>Tanacetum</i>	67	<i>Vicia</i>	31
<i>Taraxacum</i>	71	<i>Vilfa</i>	142
<i>Tecoma</i>	90	<i>Viola</i>	15, 153
<i>Tephrosia</i>	29	<i>Violacæ</i>	15
<i>Teucrium</i>	91	<i>Vitacæ</i>	25
<i>Thalictrum</i>	3	<i>Vitis</i>	25

	PAGE.		PAGE.
Wolffia	121	Xyris	137
Woodwardia	149		
Xanthium	62	Zannichellia	
Xanthoxylum	23	Zizania	
Xyridaceæ	117	Zizia	44



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Preliminary Outline

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New Classification of the Family Muricidæ

— BY —

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Secretary and Curator.



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PRÉLIMINARY OUTLINE OF A NEW CLASSIFICATION OF THE FAMILY MURICIDÆ.

BY FRANK COLLINS BAKER.

For several years the writer has been accumulating data bearing upon the natural classification of the Gastropod family Muricidæ. It has been thought desirable to place before students some of the results elucidated, and to invite their friendly criticism.

Of all the groups of Prosobranchiate Mollusks, none are more difficult to naturally classify than this family; the shells and soft parts are so similar in general form, that it is almost impossible to find stable characters upon which to base a sound division into groups. The divisions of most of the old writers are unnatural, having been based on shell characters alone, and in many cases, as in the groups *Phyllonotus* and *Ocinebra*, there has been a hopeless mingling of several distinct forms. Most modern authors have gone to the other extreme, and divided the family into a large number of useless and ill-defined sections, which has only helped to bring the group into still further confusion. The author's aim in the present paper has been simply to place before malacologists the outline of a classification essentially modern and essentially original. It can scarcely be hoped that all will agree with the classification here adopted; but it is hoped that it will be found an improvement over previous systems.

The notes given under each group must not be taken for complete diagnoses. Only the principle characters are given. In diagnosing the genera and subgenera, the following characters must

be taken into account: form of the *shell*, whether with varices or simple foliations, or smooth; form of *operculum* and position of nucleus; form of *animal*, length of proboscis, shape of tentacles and position of verge; character of the *lingual ribbon*, number and position of teeth and denticles.

It is an astonishing fact that of the six hundred and odd valid species of the family, scarcely ten per cent. have been examined for the animal and dentition. It may not be out of place to call attention, right here, to the manner of extracting and mounting the lingual ribbon, as there are a large number of species in which this organ is not known, and knowledge on this subject is much needed. This ribbon, also called the radula, is a strap or belt of chitinous or horny matter, occupying the place in the mouth of the animal analogous to that occupied by the tongue in the vertebrates. The inner end of the radula is secreted by a glandular surface lining a pouch which lies under and behind the cartilaginous and muscular buccal mass upon which the ribbon is carried. The front end of the ribbon is attached to the cuticle. The surface of the radula is set with teeth disposed in rows, transverse and longitudinal; the front rows differ only from those in the rear in maturity; only the first few rows are brought into active use; the rest form a reserve to be called into use when the first have been worn out. The buccal mass is protrusile, and may be readily studied by feeding a snail soft crumbs of bread. In the larger forms, the radula is easily recognized, and can be dissected away with very little trouble. In most of the Murices it is found at the retracted tip of the inverted proboscis. Some of the forms, as the smaller *Ocenebras*, *Typhis* and *Purpuras*, cannot be dissected in the ordinary way, and must be boiled in caustic potash. This is accomplished as follows: extract the animal from its shell, place in a test tube containing about a tablespoonful of caustic potash which has attracted the atmospheric moisture until it has become liquid. Take the test tube between a pair of forceps, and hold it at the side of the flame of an alcohol lamp until it boils, being careful not to let it boil over. Be very careful that the animal matter is not thrown out of the liquid on to the dry side of the tube. Should this happen, dislodge it by shaking the liquid over it. Boil slowly until all the animal matter is dissolved; then

pour it out quickly into a watch crystal, refill the test tube with water and pour into another watch crystal. Give the first crystal a rotary motion, not too violent, so as to bring the solid particles to the center. Examine with a powerful hand lens; a sheet of white paper under the watch crystal will greatly aid in discovering the radula. This will be recognized by its curved, elongate shape and apparently reticulated surface. If the radula is not found in the first crystal, examine the second. When found, in either one of the two crystals, transfer to a glass slide and examine under the microscope with powers ranging from one inch to one-eighth inch. It had best be examined by transmitted light.

After examining and sketching the form of the radula, it will be necessary to tear the ribbon up so as to get separate rows and individual teeth, since they lie over one another like shingles on a roof. The whole of one tooth cannot always be seen under one focus, because the recurved cusps of the teeth are higher than the base. When the teeth are very transparent, it will be found necessary to stain the radula. To do this, first carefully clean the radula, then put it in a drop of strong solution of chromic acid; this stains it yellowish brown. It may then be mounted temporarily in glycerine jelly, or permanently in Canada balsam.

The teeth are disposed upon the radula in three principal longitudinal rows, which are easily distinguished. There is always one median longitudinal row of unpaired teeth, with a single row on either side. The central tooth is called the median or *rhachidian* tooth. The teeth on either side are called *uncini*. In describing the teeth, note should be made of the form of the base of attachment, especially in the rhachidian; also other special characteristics such as simple, straight, curved or compound. Each tooth (as the rhachidian) may be made up of a number of projections called cusps, and great care should be used in describing and sketching these. In describing the teeth, we use a dental formula to express the number and situation of the teeth and cusps; thus, if a radula has a single rhachidian and one uncinal tooth on each side, and the rhachidian tooth has five cusps, we would express the formula as follows:

$$1 + \frac{1}{5} + 1.$$

The unit representing the tooth is written as a numerator and the number corresponding to the cusps as a denominator. In the example given, the uncini are long and prong-like and the cusp number is omitted. This is the case with all the Muricidæ. Careful drawings should always be made of both teeth and cusps, as well as accurate descriptions.

In describing the animal the following points should be carefully noted: shape and size of foot and position of operculum, with any peculiarities of same; shape of tentacles and position of eyes on same; size and shape of proboscis (if measurements are taken they should be in millimetres) size, shape, and position of verge (penis); color of animal, whether spotted or uncolored; size and shape of siphon occupying anterior canal. In the operculum the following points should be noted: size, shape and color, position of nucleus and surface sculpture, whether smooth or straight. In describing the shell, every point should be taken into consideration, such as size, number of varices, spiral and longitudinal sculpture, embryonic apex, size of aperture and condition of outer lip—simple, plicate, or dentate—anterior canal, whether long or short, open or closed, straight or curved; color, etc., etc.

In the following classification I have taken advantage of every character—shell, animal, operculum and radula. In my opinion, no one character can be picked out and used to the exclusion of all others, in any classification. Many of the older authors depended wholly upon conchological characters, and the result has not been at all satisfactory. In the following pages a number of groups are diagnosed in which some of the characters are not known (at least to me), and should any reader of this paper possess such information—either from original observation or from some publication unknown to me,¹ it would be greatly appreciated.

1. The principal authorities consulted are the following:

- Adams, H. & A., *Genera of Recent Mollusca*.
American Journal of Conchology.
Annals and Magazine of Natural History.
 Baker, Frank C., *Proc. Acad. Nat. Sci. Phil.*, 1889-1891.
Boston Journal of Natural History.
 Bronn and Kefnerstein, *Klassen und Ordnungen der Weichthiere*.
 Dall, W. K., numerous papers in *Bull. Mus. Comp. Zool. Harvard College*,
 and *Proc. and Bull. U. S. Nat. Museum*.

Primarily the Murices are divisible into three groups, as follows:

- a. Shell canaliculate; whorls crossed by spinose or foliated varices; operculum ovate, with subapical or apical nucleus; verge narrow, club shaped, generally straight, but sometimes curved; dentition: the rhachidian tooth with but few cusps generally; formula as a rule, $1 + \frac{1}{2} + 1$.

SUBFAMILY I. MURICINÆ.

- b. Shell with short canal or a simple notch; whorls ribbed, nodulous, or smooth; columella broad and flattened; operculum oblong, with lateral nucleus; verge thick, curved, tapering; dentition: the rhachidian tooth with (generally) numerous cusps, formula ranging from $1 + \frac{1}{2} + 1$ to $1 + \frac{1}{4} + 1$.

SUBFAMILY II. PURPURINÆ.

- c. Shell with short canal; ribbed or frilled, scabrous; when adult free, or forming more or less irregular extensions of the outer and inner lips; living in coral; operculum ovate, nucleus sublateral, sometimes wanting; verge straight, swollen, club shaped; radula wanting (?)

SUBFAMILY III. CORALLIOPHILINÆ.

Fischer, *Manual de Conchyliologie*.

Journal de Conchyliologie.

Küster, *Systematischen Conchylien Cabinet*.

Lischke, *Japanische Meeres Conchylien*.

Malakozoologische Blätter.

Nachrichtsblatt der deutschen malakozoologischen Gesellschaft; also *Jahrbücher of the same*.

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" *Linn Soc. New South Wales*.

Say, Thomas, complete writings (By W. G. Binney.)

Troschel, *Das Gebiss der Schnecken*.

Tryon, Geo. W., Jr., *Manual of Conchology*.

Verrill, A. E., numerous papers in *Trans. Conn. Acad. Sciences*, and *Report U. S. Fish Commission*.

Watson, R. Boog, *Mollusca of Challenger Expedition*. In "*Challenger Reports*."

Also numerous scattered papers in different *Proceedings and Transactions*.

SUBFAMILY I. MURICINÆ.

The principal characteristics of this group are, the spiny or nodulous varices and long canal; operculum with terminal initial point, a long, narrow, and club shaped verge, and a distinct muricoid dentition. There are, however, on the confines of this group, species which seem to partake of the characters of both *Murex* and *Purpura*, as certain forms of *Ocinebra*, *Urosalpinx* and *Trophon*. It is difficult, therefore, to draw up a diagnosis which will include all of one group to the exclusion of all others.

Genus MUREX Linné, 1758.

Shell ovate or oblong; spire always prominent, whorls rounded, crossed by three or more spinose or foliated varices; canal long or short, always distinct, partly open.

Animal with a large, broad foot; tentacles long and tapering, the eyes situated on the outside, near the end; proboscis cylindrical, long; verge long, club shaped, situated on the right side behind the tentacle.

Operculum ovate, with subapical nucleus.

Dentition $1 + \frac{1}{2} + 1$; the lateral cusps of the rhachidian tooth very large, the next two very small, and the central cusps very large; base of rhachidian tooth quadrate, uncini with single cusps, long and prong-like.

Type. MUREX TENUISPINA, Lam.

Subgenus MUREX (typical).

Shell more or less pyriform, spinose, with three varices; whorls rounded, crossed by distinct spiral lines; spire elevated; canal very long, nearly straight, partly closed; aperture ovate, the outer lip sometimes toothed.

Animal, *operculum* and *dentition* as in the genus.

Type. MUREX TENUISPINA, Lam.

Section HAUSTELLUM Klein., 1753.

Shell differs from *Murex* (typical) in the absence of spines, in the aperture being nearly circular, and in the canal being closed. Spire more compressed.

Animal, *operculum* and *dentition* as in the genus.

Type. MUREX HAUSTELLUM, Linné.

Subgenus *BOLINUS*² Peusch, 1837.

Shell ovate-pyriform, spinose, with six varices; whorls rounded, spiral sculpture very fine; spire depressed; canal very long, straight, nearly closed; aperture ovate, the outer lip simple; varices very large and strong.

Animal, operculum and dentition as in the genus.

Type. *MUREX BRANDARIS*, Linné.

Subgenus *CHICOREUS* Montf., 1810.

Shell ovate-pyriform, with three varices, foliated, seldom spinose; whorls rounded, spiral sculpture generally very strong; spire elevated; canal short, curved, wide, nearly or quite closed; aperture ovate, outer lip simple.

Animal, operculum and dentition as in the genus.

Type. *MUREX PALMA ROSÆ*, Linné.

Subgenus *HOMALOCANTHA* Mörch, 1852.

Shell ovate-pyriform, with from five to eight varices; varices foliated and produced into peculiar expanded digitations; whorls rounded, sutures very deep; spire but little elevated; canal rather long, nearly straight and almost closed; aperture ovate, outer lip crenulated.

Animal, operculum and dentition as in the genus.

Type. *MUREX SCORPIO*, Linné.

Subgenus *PHYLLONOTUS* Swainson, 1840.

= *Muricantha*, Swainson, 1840.

Shell broadly ovate, with from four to fifteen scaly or foliated varices; whorls rounded, spiral sculpture well developed; spire ranging from depressed to considerably elevated; canal of moderate length, curved, nearly closed; aperture ovate, outer lip crenulated.

Animal, operculum and dentition as in *Murex*.

Type. *MUREX RADIX*, Gmelin.

Subgenus *PTERONOTUS* Swainson, 1840.

Shell triangular, with three varices; varices fin-like or foliated; whorls rounded; spire elevated; canal moderately straight or somewhat curved, nearly closed; aperture oblong-ovate, the outer lip generally simple, but sometimes crenulated.

Animal, operculum and dentition as in the genus.

Type. *MUREX PINNATUS*, Wood.

²This name should take precedence over that of *RHINOCANTHA*, H. and A. Adams, published in 1833.

Genus EUPLEURA³ H. and A. Adams, 1853.

Shell Ranelliform, with two lateral varices, and from four to twelve intermediate smaller varices; the lateral varices are sometimes not developed, and in these cases the shell is equi-varicose; varices foliated; whorls rounded; spire elevated; canal rather long, nearly straight, partly closed; aperture ovate, dentate within.

Animal with a short, rounded foot, truncate behind; tentacles long, tapering from base to tip, with the eyes about midway; verge on the right side, behind the tentacle, turned back in a curve, compressed at base, rounded and blunt at the tip.

Operculum like that of *Murex*.

Dentition $1 + \frac{1}{2} + 1$, the three lateral cusps of the rhachidian tooth very small, the three central cusps very large; the single-cusped uncini long, narrow and hooked.

Type. EUPLEURA CAUDATA, Say.

Genus XANTHOCHORUS⁴ Fischer, 1884.

Shell broadly-ovate, thick, heavy; whorls rounded; varices numerous, fimbriated, crossed by from six to ten revolving ribs, the interstices crowded with incised revolving lines; spire not much elevated; canal very short, open, straight; umbilicus open; outer lip thick, dentate within.

Animal with a short, wide foot, rounded behind, truncate before; tentacles long, tapering from base to tip; eyes on prominences at the base of the tentacles; verge large and swollen, situated on the right side behind the tentacle; proboscis of medium size, cylindrical.

Operculum muricoid.

Dentition $1 + \frac{1}{2} + 1$; the three central cusps of the rhachidian tooth large and equal in size; uncini long, slender, pointed.

Type. XANTHOCHORUS XANTHOSTOMUS, Brod.

Genus FORRERIA⁵ Jouss., 1880.

Shell pyriform, thick and heavy; whorls triangular, with numerous semi-foliated varices; no spiral sculpture; spire not much elevated; canal of moderate length, open, straight; umbilicus large, open; aperture long-ovate, outer lip with a tooth at the base.

Animal resembling that of *Purpura*.

³ In removing this genus from the vicinity of *Urosalpinx* to its present location, my position is fortified by the opinion of Mr. W. H. Hall, Mr. Chas. Simpson, and others. The shell is decidedly like *Pteronotus* and the operculum is the same as that of *Murex*.

⁴ The thick and heavy shell, dentate lip and operculum, are, in my opinion, characters sufficiently marked to place this section in its present position as a genus.

Operculum purpuroid.

Dentition $1 + \frac{1}{2} + 1$, the three cusps of the rhachidian tooth equal in size, triangular in shape, and very sharp, like the teeth of a saw; uncini curved and hook-like, very broad.

Type. *FORRERIA BELCHERI*, Hinds.

Genus *TROPHON* Montfort, 1810.

Shell fusiform or broadly-ovate, thick or thin, whorls rounded or shouldered; umbilicus open or closed; varices numerous, sharply laminated, the interstices smooth or spirally ribbed; spire usually elevated, canal moderate, open, generally turned to the left; aperture oblong-ovate or rounded, outer lip thin or thick, smooth or dentate within.

Animal with a short, rounded foot; tentacles long, tapering from base to tip, with the eyes situated on prominences near the base; proboscis of medium size, cylindrical.

Operculum of the purpuroid type, with an apical or sub-lateral nucleus.

Dentition $1 + \frac{1}{2} + 1$, $1 + \frac{1}{3} + 1$, or $1 + \frac{1}{4} + 1$, the central cusp of the rhachidian tooth very large, and in the case of the five and seven cusped rhachidians, a large cusp alternates with a small one; uncini long and fang-shaped.

Type. *TROPHON GEVERSIANUS*, Pallas.

Subgenus *TROPHON* (*sensu stricto*).

Shell broadly-ovate, rounded or strongly shouldered, with numerous sharp, laminated varices, the interstices smooth or spirally ribbed; spire elevated; canal short, open, nearly straight; aperture rounded, outer lip simple, umbilicus open.

Animal as in the genus.

Operculum variable; the growth being lateral, causing the nucleus to appear as if on the outer side instead of the lower extremity, thus resembling that of *Purpura*.

Dentition $1 + \frac{1}{2} + 1$, the cusps of the rhachidian tooth very large and equal in size; uncini long and pointed.

Inhabits Antarctic seas.

Type. *TROPHON GEVERSIANUS*, Pallas.

* This form has usually been classified under the genus *Chorus*, Gray, but the type of that genus is the *Moniceras giganteum* of Lesson. It was placed in *Trophon* as a section by Fischer, but I believe the better disposition to be as a separate genus, between *Xanthochorus* and *Trophon*.

Subgenus *BOREOTROPHON* Fischer, 1884.

Shell fusiform, rather thin; whorls rounded or distinctly shouldered, crossed by numerous laminated varices; spire elevated; canal long, straight or slightly curved, open; umbilicus closed; aperture ovate or rounded, outer lip simple or crenulated.

Animal as in the genus.

Operculum elongated, acute, with a nearly apical nucleus.

Dentition $1 + \frac{1}{2} + 1$, or $1 + \frac{1}{4} + 1$, the central cusps of the rhachidian tooth very long and pointed, the lateral cusps of uneven size; uncini long and prong-like, as in the genus.

Boreal in distribution.

Type. *TROPHON CLATHRATUS*, Linné.

Section *TROPHONOPSIS*⁶ B. and D., 1882.

Shell differing from *Boreotrophon* in being more regularly fusiform, with more numerous varices.

Animal with a longer foot and tentacles, the eyes situated on swellings near the base.

Operculum as in *Boreotrophon*.

Dentition $1 + \frac{1}{2} + 1$, the cusps as in *Boreotrophon*.

Type. *TROPHON MURICATUS*, Mont.

Subgenus *ASPELLA* Mörch, 1877.

Shell fusiform, with a tendency toward lateral compression; whorls rounded, varices numerous; spire elevated; canal short, recurved, always open; aperture denticulate in the adult; nucleus small, at first obliquely and loosely wound, like a stranded rope, having a strong resemblance to a reversed nucleus.

Animal with a large foot, rounded behind, double edged in front, auriculated in the anterior corners; proboscis moderately long; tentacles small, close together, the eyes situated on their outer sides, half way between base and tip.

Operculum elongated, acute, with an apical nucleus.

Dentition $1 + \frac{1}{2} + 1$, resembling that of *Phyllonotus*.

Type. *TROPHON ANCEPS*, Lam.

⁶ It is with some doubt that I make this group a distinct section. It is altogether too nearly related to *Boreotrophon*. The shell, however, shows some differential characters, and it may be found convenient, at least, to retain the group as a section of *Boreotrophon*.

Genus OCINEBRA Leach, 1847.

Subgenus OCINEBRA (*sensu stricto*).

Shell fusiform, with from three to fourteen varices; varices rounded; umbilicus closed; spire elevated; canal moderate, open or closed, turned to the left; aperture round or ovate; outer lip dentate within.

Animal with a small, narrow foot, rounded in front, pointed behind; tentacles long, slender, tapering; eyes on long stalks exterior to and united with the tentacles for two thirds of their length; verge situated on the right side, behind the tentacles.

Operculum like that of *Murex*, with the nucleus anterior, but not apical, and somewhat laterally situated.

Dentition $1 + \frac{1}{3} + 1$, the three central cusps of the rhachidian tooth large, the others smaller; uncini long and pointed.

Type. OCINEBRA ERINACEUS, Linné.

Section CRASSILABRUM JOUSS, 1880.

Shell broadly-ovate, with numerous varices; varices thick and cord-like, crossed by several equally thick spiral cords, giving the shell a latticed aspect; umbilicus closed; spire elevated; canal short, open, nearly straight.

Animal as in *Ocinebra* (*s. s.*)

Operculum and *dentition*, unknown to me.

Type. OCINEBRA CRASSILABRUM, Gray.

Section OCINEBRINA JOUSS., 1880.

Shell fusiform, with numerous rounded varices (ribs) crossed by strong spiral lines; spire elevated; canal short, open, straight; aperture ovate, outer lip dentate within.

Animal with a small, narrow foot, rounded before, pointed behind; tentacles long, slender, tapering, microscopically ciliated, especially at the blunt tips; eyes and verge as in *Ocinebra* (*s. s.*)

Operculum of the purpuroid type.

Dentition $1 + \frac{1}{3} + 1$, the central cusp of the rhachidian tooth very large, the lateral series with a large cusp at each end, and smaller ones in between; uncini long and prong-like.

Type. OCINEBRA ACICULATUS, Lam.

Subgenus FAVARTIA Jouss., 1880.

Shell fusiform, with numerous rounded varices, crossed by raised spiral lines; umbilicus closed, spire elevated, canal moderate, nearly closed; aperture rounded, outer lip slightly plicate within.

Animal as in *Ocinebra*.

Operculum ovate or rounded, with apical nucleus.

Dentition unknown to me.

Type. OCINEBRA BREVICULA, Sowb.

Subgenus PTEROXYTIS⁷ Conrad, 1862.

=*Cerastoma* Conrad, 1837.

Shell fusiform, ovate or pyriform, with three foliated or fin-like varices, spire moderately elevated; no umbilicus; canal short, straight, closed; aperture oblong-ovate, outer lip dentate within, with a produced tooth near its base.

Animal as in *Ocinebra*.

Operculum ovate, with lateral nucleus.

Dentition muricoid.

Type. OCINEBRA NUTTALLII, Conr.

Genus VITULARIA Swainson, 1840.

Shell oblong, with numerous, nearly obsolete varices; no distinct spiral sculpture; umbilicus open or closed; spire elevated; canal short, straight, open; aperture a long oval, outer lip strongly dentate within.

Animal as in *Ocinebra*.

Operculum oblong, smaller than the aperture, rather thin, nucleus lateral.

Dentition unknown to me.

Type. VITULARIA SALEBROSA, King.

Genus MURICIDEA (Swains.) Mörch, 1840.

Shell fusiform, with numerous spiny varices or rounded ribs; umbilicus closed; spire elevated; canal moderate, open, curved; aperture oblong or rounded, outer lip generally plicate within.

Animal as in *Murex*.

Operculum resembling that of *Fusus*, ovate, with apical nucleus.

Dentition unknown to me.

Type. MURICIDEA HEXAGONA, Lam.

⁷The name *Cerastoma* was used by Labrille, in 1802, for an apparently valid genus of *Lepidoptera*. The only course to be adopted is to accept Conrad's name proposed in 1862 for a group of fossil *Murices*, closely related to *Cerastoma*.

Genus UROSALPINX Stimpson, 1865.

Shell short-fusiform, with numerous longitudinal ribs, crossed by raised spiral lines; umbilicus closed; spire elevated; canal short, open, curved; aperture oval, outer lip dentate or lirate within.

Animal small, foot scarcely large enough to fill the aperture; head scarcely protruded; tentacles nearly united at their base, tapering to a mere filament; eyes situated at upper third of the tentacle, on the outside. Verge as in *Murex*.

Operculum externally like *Murex*; semi-cordate, with the nucleus at the outer edge, a trifle below the middle; internally showing gyratory scars as in *Purpura*.

Dentition $1 + \frac{1}{2} + 1$, the rhachidian tooth with numerous minute denticles between the principal cusps; uncini long and prong-like.

Type. UROSALPINX CINEREUS, Say.

Genus TYPHIS Montfort, 1810.

Shell pyriform or oblong, with four varices;^a umbilicus scarcely visible; whorls shouldered, with projecting hollow tubes continuous with or between the varices; spire depressed; canal moderate, closed, nearly straight, aperture sub-orbicular.

Animal resembling *Murex*. The ascending tube (this is at first not a hollow cylinder, but a fold of the mantle) is occupied by an extension of the mantle margin. Foot long and narrow; tentacles thick and broad; eyes situated at their base.

Operculum ovate, with sub-apical nucleus, like that of *Murex*.

Dentition unknown to me.

Type. TYPHIS TETRAPTERUS, Bronn.

Section I. TYPHIS (Typical).

Ascending tube placed between the varices.

Animal, *operculum* and *dentition* as in the genus.

Type. TYPHIS TETRAPTERUS, Bronn.

Section II. TRUBATSA Dall, 1889.

Ascending tube continuous with varices.

Animal, *operculum* and *dentition* as in the genus.

Type. TYPHIS LONGICORNIS, Dall.

^aNotwithstanding the fact that this genus has been described as three-varicose by almost every monographer, I maintain, and so will all who will examine *carefully* a specimen, that it is four-varicose. I may add that I have never seen a specimen with three varices, either fossil or recent.

SUBFAMILY II. PURPURINÆ.

The principal characters of this group are, the short, merely notched canal, the comparatively smooth whorls (in some species nodulous, however), the broad and fattened columella, operculum with lateral nucleus, and rhachidian tooth of the radula with numerous dentacles. The same rule applies to this group, as that spoken of under *Muricida*.

Genus PURPURA Brug., 1789.

Shell oblong-oval, whorls smooth or nodulous; last whorl very large; spire generally short; aperture ovate, very large; canal short, oblique, often a mere notch; columella flattened; outer lip generally simple, sometimes lirate.

Animal with a large foot, truncate in front, pointed behind (the foot is not as large, comparatively, as in *Murex*); head very distinct; tentacles sometimes placed on stalks near the base; siphon generally short; verge as in *Murex*.

Operculum ovate or elongate, with lateral nucleus, showing on the interior gyrate scars.

Dentition $1 + \frac{1}{2} + 1$ to $1 + \frac{1}{2} + 1$; the three central cusps very large, the lateral cusps very small; uncini long and fang-like.

Type. PURPURA PERSICA, Linné.

Subgenus PURPURA* (Typical).

Shell oblong oval, whorls smooth; last whorl very large, occupying three-quarters of the length of the shell; spire short; aperture ovate, flattened; outer lip lirate within.

Animal and *operculum* as in the genus.

Dentition $1 + \frac{1}{2} + 1$, the middle cusp of the rhachidian tooth very long, the middle side cusps small, and the lateral cusps larger; uncini long and pointed.

Type. PURPURA PERSICA, Linné.

Subgenus PURPURELLA Dall, 1872.

Shell oblong-oval, whorls covered by rounded nodules; last whorl very large; canal a mere notch, spire depressed; aperture ovate, outer lip dentate within; columella flattened, with one or two distinct spiral ridges upon its center, extending from columella to apex.

Animal and *operculum* as in the genus.

Dentition as in *Purpura*.

Type. PURPURA COLUMELLARIS, Lam.

*Hutton (P. N. Z. Inst., vol. XVI, 1883) has diagnosed a new genus (*Lepsia*) for *Purpura haustum*, Martyn, but I can see no really distinctive characters by which to separate it from *Purpura* (typical).

Subgenus TRIBULUS Klein, 1753.

Shell oval, whorls nodulous; last whorl very large, ventricose; aperture very wide, ovate; inner lip excavated, corrugated at the fore-part; outer lip dentate within; canal very short; spire depressed.

Animal and *operculum* as in the genus.

Dentition $1 + \frac{1}{1} + 1$, the three central cusps of the rhachidian tooth very large and prong-like, with a small denticle between, the three lateral denticles very small; uncini long and fang-like.

Type. PURPURA PLANOSPIRA, Lam.

Subgenus THALESSA H. and A. Adams, 1853.

Shell ovate or pyriform; whorls smooth or nodulous; angulated at the upper part; spire elevated; aperture occupying half the length of the shell, ovate; columella rounded, tubercular in front; canal a mere notch; outer lip nodulous within.

Animal resembling that of *Purpura*, but foot smaller and longer.

Operculum as in *Purpura*.

Dentition $1 + \frac{1}{2} + 1$, the central cusp of the rhachidian tooth very large, the next two large and bifid; lateral cusps very small; uncini long and pointed.

Type. PURPURA HIPPOCASTANEUM, Linné.

Subgenus STRAMONITA Schum., 1817.

Shell ovate; whorls simple or nodulous; spire elevated; aperture moderate, produced anteriorly; columella rounded, simple in front; canal short; outer lip lirate within.

Animal and *operculum* as in *Purpura*.

Dentition $1 + \frac{1}{2} + 1$, $1 + \frac{1}{1} + 1$, the cusps of the rhachidian tooth as in *Thalessa*. Uncini as in the preceding groups.

Type. PURPURA HÆMASTOMA, Linné.

Subgenus TROCHIA Swains., 1840.

Shell ovate; whorls crossed by numerous raised spiral lines or ribs, and separated by deep grooves; spire usually elevated; aperture moderate; canal short; columella rounded, slightly excavated near the base; outer lip thickened, convex, lirate within.

Animal and *operculum* as in the genus.

Dentition as in *Thalessa*.

Type. PURPURA CINGULATA, Linné.

Subgenus POLYTROPA Swains., 1840.

Shell a long oval; whorls foliated or tuberculose; spire acuminate; aperture rounded, narrowed at the fore part; canal short, oblique; columella arcuate; outer lip smooth or lirate within.

Animal with a small foot; other characters as in the genus.

Operculum as in *Purpura*.

Dentition $1 + \frac{1}{3} + 1$, the cusps of the rhachidian tooth large and of equal size; uncini as in *Purpura*.

Type. PURPURA LAPILLUS. Linné.

Subgenus CRONIA H. and A. Adams, 1853.

Shell long-ovate; whorls crossed by raised spiral lines; spire acuminate; aperture long-ovate, moderate; canal very short; inner lip with a callous at the upper part; columella straight, simple anteriorly; outer lip dentate or lirate within.

Animal and *operculum* as in the genus.

Dentition unknown to me.

Type. PURPURA AMYGDALA, Kiener.

Subgenus AGNEWIA¹⁰ Tenison-Woods, 1877.

Shell long-ovate, inclining to fusiform; whorls ribbed or nodulous; spire acuminate; aperture small, rounded; canal a mere notch; columella arcuate, smooth; outer lip lirate within.

Animal and *operculum* as in *Purpura*.

Dentition unknown to me.

Type. PURPURA TYPICA, Dunker.

Genus RAPANA Schum., 1817.

Shell ventricose, axis perforated to the apex; whorls angulated at the shoulder; spire depressed; aperture oval, narrowed anteriorly, canal short, open, slightly recurved; inner lip reflected, free anteriorly; umbilicus wide, corrugated; outer lip smooth or very slightly lirate within.

Animal and *operculum* resembling that of *Purpura*.

Dentition $1 + \frac{1}{3} + 1$, the central cusp of the rhachidian tooth very large, the two on either side large, and strengthened by several small denticles; lateral cusps small; uncini long and fang-shaped.

Type. RAPANA BULBOSA, Solander.

¹⁰Dunker characterized the genus *Adamsia* in 1856; but this name being preoccupied by E. Forbes in *Anthozoa*, Rev. E. Tenison-Woods, in 1877, changed the name to *Agnewia*. The genus has been placed in *Cominella* and *Urosalpinx*, but its proper place is, I believe, in *Purpura*.

Genus CYMIA¹¹ Mörch, 1877.

Shell short fusiform; whorls strongly angulated in the middle; spire elevated; aperture ovate; canal short, open; columella with a large plait running clear up to the apex; inner lip reflected; umbilicus open, corrugated; outer lip lirate within.

Animal and *operculum* resembling *Purpura*.

Dentition $1 + \frac{1}{2} + 1$, the central cusp of the rhachidian tooth very large, the next two smaller and bifid, and the lateral cusps very small; uncini long and fang-shaped.

Type. CYMIA TECTUM, Wood.

Genus JOPAS H. and A. Adams, 1853.

Shell ovate; whorls rugose, last large; spire acuminate; aperture moderate; emarginate and channeled in front; columella covered with a thin enamel; with a prominent plait-like callosity near the anterior canal; canal short, open; outer lip sinuous, crenate within.

Animal resembling that of *Purpura*; the foot is long and narrow, truncate before, rounded behind; head distinct; tentacles moderate, tapering, the eyes situated about a third of the distance from the outside; verge as in *Purpura*.

Operculum purpuroid.

Dentition $1 + \frac{1}{2} + 1$, the central cusp of the rhachidian tooth very large, lateral cusps smaller; uncini long and pointed.

Type. JOPAS SERTUM, Brug.

Genus VEXILLA Swains., 1840.

Shell long-ovate; whorls smooth; spire moderate; aperture very long and narrow; inner lip flattened and depressed; outer lip thickened (in the adult) and dentate within; canal very short.

Animal resembling that of *Purpura*; foot long and narrow, truncate before, rounded behind; tentacles and eyes as in *Jopas*.

Operculum purpuroid.

Dentition unknown to me.

Type. VEXILLA VEXILLUM, Chemn.

Genus PINAXIA H. and A. Adams, 1850.

Shell conical; spire short, acute; whorls smooth, tuberculose on the shoulder; aperture oval-oblong, emarginate anteriorly; inner lip flattened, with several transverse plaits in the middle; outer lip acute, grooved internally; canal very short.

Animal unknown.

Operculum purpuroid.

Dentition unknown.

Type. PINAXIA CORONATA, A. Adams.

¹¹The name *Cuma* (Humph, 1797) Swains., 1840, is generally used for this group, but that name is used for a group of Crustacea.

Genus ACANTHINA¹² Fischer, 1807.

Shell ovate, last whorl large, rough or smooth; spire moderate or very short; aperture ovate or semilunar; inner lip wide and flattened; outer lip thick or thin, crenated, with a prominent tooth at the fore part; canal very short, open.

Animal with a short, narrow foot, rounded at both ends; head distinct; tentacles long and tapering, widely separated at their base; eyes placed upon swellings midway between base and tip; siphon of medium size; verge as in *Purpura*.

Operculum purpuroid, triangular.

Dentition $1 + \frac{1}{2} + 1$, the central cusp of the rhachidian tooth triangular; those next triangular and tridentate; the lateral cusps ovate, and smaller; uncini as in *Purpura*.

Type. ACANTHINA IMBRICATA, Lam.

Subgenus CHORUS¹³ Gray, 1847.

Shell resembling *Acanthina*, but with longer spire and canal; the shell is smooth, and the tooth on the outer lip very large. It is separated from *Acanthina* chiefly by its pyriform shell.

Animal, operculum and *dentition* as in *Acanthina*.

Type. ACANTHINA GIGANTEUM, Lesson.

Genus PENTADACTYLUS¹⁴ Klein, 1753.

Shell ovate, very solid; varices nodulous or scaly; spire very short; aperture linear, narrow, contracted by callous projections; inner lip tubercularly wrinkled; outer lip with plait-like teeth, within digitate; canal short, oblique, open, emarginate in front.

Animal with a rather broad foot; head distinct; tentacles long, thick, separated at base; eyes situated on the outside midway between base and tip; siphon of medium size; verge as in *Purpura*.

Operculum purpuroid.

Dentition $1 + \frac{1}{2} + 1$ to $1 + \frac{1}{3} + 1$, the central cusp of the rhachidian tooth large, triangular, the cusps immediately to right and left bi or trifid, the lateral cusps small and placed like the teeth of a rake; uncini long and fang-like.

Type. PENTADACTYLUS RICINUS, Lam.

¹²This name has priority over *Monoceras* Lam., 1809.

¹³The type of this genus is not the *Chorus Belcheri* of Hinds (*Forreria*, Jous.), but the *Monoceras giganteum* of Lesson.

¹⁴This name should take precedence over that of *Ricinu*la. Lam., 1812. *Morus*., Mont., 1810, is a synonym of *Pentadactylus*, and does not represent the small forms, like *P. morus*, as most authors have written it.

Subgenus MORULA Schum., 1817.

Shell with a longer spire, smaller size and more fusiform than in *Pentadactylus*. The teeth within the outer lip single, not grouped.

Animal resembling *Pentadactylus*. The eyes are sometimes placed on prominences and the foot is narrower.

Operculum as in *Pentadactylus*.

Dentition $1 + \frac{1}{2} + 1$, the central cusp of the rhachidian tooth very large, those on either side smaller and bifid, the laterals very small; uncini long and pointed.

Type. PENTADACTYLUS MORUS, Lam.

Genus CONCHOLEPAS Lam., 1801.

Shell ovate, last whorl very large, expanded; spire very short, obliquely inclined toward the left side; aperture very wide, slightly channeled anteriorly; inner lip flattened; outer lip with two small teeth in front.

Animal with a very large foot; head and tentacles as in *Purpura*; eyes placed midway between base and tip of tentacles; siphon moderate; verge as in *Purpura*.

Operculum purpuroid, but entirely too small to fill the aperture.

Dentition $1 + \frac{1}{2} + 1$, the central cusp of the rhachidian tooth large and triangular, those on each side large and bifid; lateral cusps very small; uncini long and fang-like.

Type. CONCHOLEPAS PERUVIANUS Lam.

SUBFAMILY III. CORALLIOPHILINÆ.

The principal characters of this group are the short canal, thin, in most cases scabrous shell, and its habit of living in coral; the *operculum*, when present, is ovate with sub apical nucleus; verge straight, swollen, club shaped; radula wanting (?).

Genus RHIZOCHILUS, Steen., 1850.

Shell, when young, free, resembling *Rapana*; when adult, sometimes with more or less irregular solid shelly extensions of the outer and inner lips, which clasp the axis of coral (*Antipathes*); surface of shell rough and scabrous; spire elevated; aperture long-oval; canal rather long, open.

Animal resembling *Latiauris*.

Operculum none (?).

Dentition not observed.

Type. RHIZOCHILUS ANTIPATHICUS, Steen.

Genus LATIAXIS¹⁵ Swainson, 1840.

Shell variable, or pyriform, rough and scabrous; spire very short or much elevated; aperture ovate; canal very short, open; inner lip reflected, smooth; outer lip crenate internally; umbilicus generally open and very wide and deep.

Animal with an oval, moderate foot; head and tentacles distinct, the latter rapidly tapering to a point; eyes sessile, midway between base and tip; verge (?); siphon short.

Operculum resembling *Purpura*, with the nucleus lateral.

Dentition not observed.

Type. LATIAXIS NERITOIDEA, Lam.

Subgenus CORALLIOBIA, H. and A. Adams, 1853.

Shell differing from *Latiaxis* in being broadly ovate, flattened, and with the outer lip much expanded, concealing the spire.

Animal as in *Latiaxis*.

Operculum wanting (?).

Dentition not observed.

Type. LATIAXIS FIMBRIATA, A. Ad.

Genus LEPTOCONCHUS Rüppel, 1834.

Shell ovate, thin, last whorl very large; spire very short; aperture semi-lunar; inner lip arcuate, covered with a light callous; outer lip thin, somewhat expanded; no anterior canal.

Animal with a greatly thickened and fleshy mantle margin; tentacles small, broad, and united at their bases; eyes small and black, on the outer side of the tentacles, near their tips; foot small, short, obtuse and rounded behind, with a thin, expanded disc-like lobe in front; siphon obsolete; verge straight, acuminate, swollen, club-shaped at the extremity, placed on the right side of the body.

Operculum wanting.

Dentition not observed.

Type. LEPTOCONCHUS CUMINGII, Desh.

¹⁵There has been much confusion over this generic name. I have recently examined several specimens of *Latiaxis mawae* (Gray), and am firmly convinced that it is but an abnormally loosely coiled specimen of *Coralliophila*. *Pseudomurex*, also, is a synonym; the *operculum* is identical, and the shell characters fade into one another. The synonymy, then, will stand as follows:

Latiaxis Swainson, Man., p. 206, 1840.

Coralliophila, H. & A. Adams, Gen. Rec. Moll., I, p. 135; 1853.

Pseudomurex Monterosato, Conch. Medit., p. 49; 1872.

Genus *MAGILUS*¹⁶ Montfort, 1810.

Shell when young as in *Leptoconchus*, when adult forming a long tube by the shelly expansion of the outer and inner lips.

Animal as in *Leptoconchus*.

Operculum oval, concentrically laminated, with lateral nucleus.

Dentition not observed.

Type. *MAGILUS ANTIQUUS*, Lam.

Genus *RAPA* Klein, 1753.

Shell thin, grobately pyriform; umbilicus deep, perforating the axis to the apex, the umbilicus partly concealed by the reflected inner lip; spire very short, flat; aperture oblong, produced anteriorly into a wide, sub-recurved canal; inner lip reflected; outer lip thin, crenate.

Animal resembling that of *Leptoconchus*.

Operculum purpuroid, thin and translucent.

Dentition not observed.

Type. *RAPA PAPYRACEA*, Lam.

GENERA FORMERLY INCLUDED IN THE MURICIDÆ, BUT NOW REFERRED TO OTHER FAMILIES.

Genus *PSEUDOLIVA*, Swainson. 1840.

=Buccinidæ.

Genus *MELAPIUM*, H. and A. Adams, 1853.

=Buccinidæ.

Genus *MAGILINA*, Vélain.

=Vermetus.

¹⁶*LEPTOCONCHUS* is separated from *Magilus* on account of the absence of the *operculum* in the former, and in the possession of a long tube in the latter. Should these characters prove stable, after the examination of a large amount of fresh material, then they should most certainly be separated. Many of the species placed in *Leptoconchus* are strongly suggestive of the young of *Magilus* before the tube is formed.





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Var. *Mighelsi*, Binney.

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THE GROSS ANATOMY OF LIMNÆA EMARGINATA
VARIETY MIGHELSI.—BINNEY.

BY FRANK COLLINS BAKER.

It was the writer's good fortune some time since to receive a number of living and alcoholic specimens of *Limnæa emarginata* and its variety *mighelsi* from Mr. Olof O. Nylander, of Caribou, Maine, for anatomical investigation. So little is known concerning the anatomy of our American Limnæidæ, it was deemed best to make an exhaustive study of this material. In the anatomical notes which follow, the splendid works of Bronn and Keferstein, Moquin-Tandon and Spengel have formed a safe and exhaustive basis of comparison. Of the many species of Limnæidæ found throughout Europe and America, only a few have been studied anatomically. Among these may be mentioned *L. palustris*, *L. stagnalis*, *L. auricularia*, *L. pereger*, *L. megasoma* and *L. truncatula*. In this paper comparisons are made with all but the last of these species. Generalizations and comparisons with allied genera have been reserved for a future paper, when more shall be known concerning our native species. The reader may make these comparisons for himself by consulting the works mentioned in the bibliography. Dr. Joseph Leidy's work on the American Pulmonata (in Binney, Terr. Moll. U. S., Vol. V.), in which are many beautiful drawings of pulmonate anatomy, will serve admirably as a means of comparison with the air-breathing pulmonates.

The material upon which the following notes are based is unusually fine and abundant, including, besides that already mentioned, some 250 specimens of the shells of *L. emarginata* (typical) from Western New York, collected by Dr. Howard N.

Lyon, and presented by him to The Chicago Academy of Sciences, and 200 specimens of *Limnæa emarginata* var. *mighelsi* from Maine, donated by Mr. Nylander. These two collections show every possible form of this very variable species. In addition to these there are a number of specimens in the collection of the Academy from various localities. The two half-tone plates well illustrate the variability of this species.

About fifty specimens have been dissected and some two hundred and fifty examinations made. Both the typical form of *emarginata* and the variety *mighelsi*, obtained from Maine, have been made a part of this study, but the typical form from New York has not been dissected, as no living or alcoholic specimens were available. The forms from Maine agree in all important details, but whether this would be true of those from New York is uncertain. All of the specimens (with two or three exceptions) were adult, and there was little variation among the different organs. Recent illustrations of the animals of this genus do not, as a rule, show the correct form of the peculiar velum; Lankester's figure 70, in the article Mollusca, Zoological Articles, p. 123, is the only correct recent drawing the writer has seen. The velum varies to some extent among the different species and also among different specimens of the same species, and similar specimens will also vary at different times (see plate III, figures A, B, C.)

In examining this species, marked differences between alcoholic and fresh specimens were observed. The former differed much in color and also in form, the organs being much contracted and distorted. My observations indicate that it is unsafe to describe anatomical details from alcoholic specimens. Accordingly, the notes which follow are taken only from specimens freshly killed by drowning.

The specimens received from Mr. Nylander were kept alive for several months. In captivity the animal is sluggish, remaining for a long time with body and foot contracted and tentacles drooping. The animal is gregarious, forming colonies made up of four or five individuals. During progression the head and velum are raised, the latter moving about in curves. Like all of the *Limnæidæ*, this species spends long periods out of the water, remaining motionless with its body and head contracted. The first day after the specimens were received several of the

larger forms ate one of their number and also defaced several shells by eating their epidermis. Various kinds of food was given them, some of which they ate with avidity, while other kinds were refused. Lettuce was always eaten with an evident relish; bread, apple and potato was always welcome. Cake, salt cracker, ginger snaps and cheese were given to them, but with one exception these were not eaten at all. One medium-sized specimen seemed ready to eat anything, even cheese. Several empty shells were placed in the water to supply the necessary lime for building up the shells.

The living and alcoholic specimens were from Cross Lake, Portage Lake, Square Lake and Aroostook River, Aroostook County, northeast Maine. Two miles south of Cross Lake inlet this species was found in large numbers in two feet of water. Mr. Nylander reports that "they seemed to feed on the vegetation on the rocks." (See *Nautilus*, XI, p. 10.)

I wish to acknowledge valuable assistance received from Mr. Olof O. Nylander, for abundant living, alcoholic and dry material; Dr. Howard N. Lyon, Chicago, for a collection of *L. emarginata* (typical); Mr. Frank M. Woodruff, for making the two excellent photographic plates of the shells; Mr. George H. Clapp, Pittsburg, Penn., for dry material; Dr. William H. Dall, U. S. National Museum, Washington, D. C., for notes concerning photographic illustrations and reference to papers for consultation; Mr. P. B. Randolph, Seattle, Wash., for specimens from Alaska; Mr. Charles T. Simpson, U. S. National Museum, Washington, D. C., and Prof. William A. Locy, of Northwestern University, Evanston, Ill., for valuable suggestions.

Limnæa emarginata Say. PLATE I.

Limnæa emarginata SAY, Journ. Phil. Acad. Nat. Sci. II, p. 170 1821; Narr. of Long's exped., p. 263, 1824; Amer. Conch., vi, pl. iv, fig. 1, 1834; BINNEY's ed., p. 67, 130 and 311, pl. iv, fig. 1, 1858, HALDEMAN, Mon. Lim., p. 10, pl. ii, 1841; DE KAY, Moll. of N. Y., p. 73, pl. iv, fig. 77, 1843; LAPHAM, Trans. Wis. State Agric. Soc., vol. ii, p. 368, 1852; Proc. Phil. Acad. Sci., p. 155, 1860; TRYON, Amer. Jour. Conch., vol. 1, p. 252, 1865; Con. Hald. Mon., p. 110, 1870; BINNEY, L. and Fr.-W. Sh. N. Am., p. 61, figs. 75-79, 1865; LEWIS, Bull. Buf. Soc. N. H., vol. ii, p. 135, 1874; INGERSOLL, Rep. Geol. Surv. Terr., p. 406, 1874; AUGHEY, Bull. U. S. Geol. Surv., p. 700, 1877; LATCHFORD, Amer. Nat., vol. xviii, p. 1051, 1884; WALKER, The Nautilus, vol. vi, p. 32, 1892; vol. ix, p. 5, 1895; NYLANDER, The Nautilus, vol. xi, p. 10, 1897.

Limnæa serrata HALDEMAN, Mon. Lim., p. 12, pl. ii, figs. 6, 7, 8, 1841; BINNEY, L. and FR.-W. Sh. N. Am., p. 52, fig. 78, 1865; TRYON, Amer. Journ. Conch., vol. 1, p. 253, 1865; Con. Hald. Mon., p. 110, 1870.

Limnæus ontariensis MUEHLFELDT in KUSTER, vide Binney, L. & Fr.-W. Sh., p. 51, 1865.

Shell: Of medium size, generally very solid, but varying from thin to thick, globosely ovate, somewhat inflated; color corneous; sometimes very dark, the epidermis plain but sometimes ornamented by longitudinal lighter bands much narrower than the darker band of the ground color of the shell; frequently there will be a broad longitudinal band of white on the last whorl, and the sutures are sometimes bordered with white; nucleus small, smooth, rounded, consisting of two chestnut-colored whorls; surface shining, lines of growth numerous, crowded, frequently wrinkled and sometimes crossed by from eight to twelve spiral ridges, giving the surface a malleated aspect; whorls $5-5\frac{1}{2}$, rounded, more or less inflated, the last large and showing a tendency to expand and flare, and also to become shouldered; spire typically sharp and pointed, but in some forms, particularly the young, it is depressed and very globose and obtuse; sutures deeply impressed, sometimes channelled; aperture roundly ovate, very large, occupying about two-thirds of the length of the shell, rounded below and somewhat narrowed above, expanded, in some specimens very much so, color dark chocolate or brownish; there is sometimes an elevated, white callus just within the outer lip, bordered with dark brown or red; peristome sharp, thin, expanded to a greater or lesser degree, enamelled, white; columella white, with a strong plait in the middle, covered with a white callus which spreads over the parietal wall and emargines the narrow, deep umbilicus; this callus forms a flaring, spreading margin, completely encircling the aperture. The aperture is frequently distorted.

Length, 26.75; breadth, 18.00; ap. length, 15.00; breadth, 9.00 mill., N. Y.

"	23.00;	"	15.50;	"	14.00;	"	10.50	"	"
"	22.00;	"	14.00;	"	14.00;	"	10.50	"	"
"	19.75;	"	10.50;	"	11.00;	"	7.00	"	"
"	19.00;	"	10.00;	"	10.00;	"	7.00	"	"
"	21.00;	"	11.00;	"	11.00;	"	7.00	"	"
"	18.50;	"	11.50;	"	11.50;	"	8.00	"	"
"	16.00;	"	10.00;	"	10.75;	"	7.00	"	"
"	15.75;	"	10.50;	"	10.75;	"	8.00	"	"
"	18.00;	"	11.50;	"	11.00;	"	7.00	"	"
"	15.00;	"	10.00;	"	10.50;	"	7.25	"	"
"	12.25;	"	9.00;	"	8.50;	"	7.00	"	"
"	16.00;	"	9.50;	"	9.50;	"	6.50	"	"
"	20.00;	"	12.50;	"	13.00;	"	8.50	"	Maine.
"	16.50;	"	10.50;	"	10.00;	"	6.50	"	"
"	11.75;	"	7.75;	"	7.50;	"	4.50	"	"

Distribution: Owasco River, foot of Owasco Lake, Cayuga Co., N. Y.; Hayden's Mills, six miles below Auburn, N. Y.; north end of Owasco Lake (Dr. Howard N. Lyon); first of four lakes, near Madison, Wis., (P. P. Carpenter); Pigeon Lake, Ontario, Canada, (George H. Clapp); Aroostook River, Caribou, Maine, (Olof. O. Nylander, October, 1895); Madison, Wis.; Lake Winnipeg; Owasco Lake, N. Y.; Lake Superior; Otter Tail Creek, Minn., (from Binney, p. 53); Lake Namokin, north of Lake Superior; lakes in the Northwest Territory, State of Maine (Haldman, p. 11); Anticosti Island, Canada, (Latchfield); Macinac Island, Mich., (Walker); Bow River, Nebraska, (Aughey); New England to Washington Territory (Ingersoll); Northern part of Michigan (Walker).

This species is extremely variable, as is well shown in plate I. The extremes of variation are so great that were it not for the abundant intermediate forms they would be declared distinct species. The type form described by Say has a long-spined, graceful shell; from this form we pass by an unbroken series to the short, stumpy form with a low spire and large, more or less spreading aperture. It is a peculiar fact that in this genus many of the species have a long and short spired variety, as is well seen in *L. catascopium* Say and its variety *pinguis* Say, *L. decollata* Mighels, and *L. stagnalis* Linne and their short-spined varieties. This connection can be seen only when a large number of specimens are examined and compared. The short-spined form of *emarginata* connects perfectly with similar forms of the variety *mighelsi*.

The writer was at first inclined to place both *L. catascopium* and *L. decollata* in the synonymy of *emarginata* (in which case it would have to be called *catascopium*, as this name was given three years earlier), but the material at hand of these two species would not permit of such a disposition. They are closely related, however, and future investigation may prove them identical. It is unsafe to base a decision on the shell alone, but rather on an examination of both shell and animal. The genitalia or muscular system may possibly give some tangible characters.

The specimens from Owasco River are generally graceful and long-spined forms, while those from Maine are short-spined and stout, showing a decided tendency toward the variety, and the same may be said of specimens from Madison, Wis. Unfortu-

nately no specimens of the animal of the typical form were available for anatomical study. The writer hopes to be able to present the results of studies of this character in a later paper.

***Limnæa emarginata* var. *mighelsi*. W. G. Binney. PLATE II.**

Limnæa ampla MIGHELS, Bost. Journ. Nat. Hist., vol. iv, p. 347, pl. xvi, fig. 1, a, b, c (April, 1843), (Preoccupied by Hartmann for *Gulnaria ampla* described in 1842); Proc. Bost. Soc. N. H., vol. i, p. 129, 1843; BINNEY, Proc. Phil. Acad. Sci., p. 330, 1861; WHITEAVES, Can. Nat., vol. viii, p. 112, fig. 11, 1863; MORSE, Terr. Pul. Maine, 1864; BINNEY, L. & Fr. W. Sh. N. A., p. 30, fig. 34, 1865; TRYON, Amer. Journ. Conch., vol. i, p. 247, 1865; Con. Hald. Mon., p. 91, pl. xvi, figs. 6, 7, 8, 1870; LEWIS, Bul. Buf. Soc. N. H., vol. ii, p. 135, 1874; MORSE, Bul. Essex Inst., vol. xii, p. 172, 1880; WALKER, The Nautilus, vol. vi, p. 34, 1892; vol. ix, p. 4, 1895; NYLANDER, The Nautilus, vol. xi, p. 10, 1897; RANDOLPH, The Nautilus, vol. xii, p. 110, 1899; WALKER, The Nautilus, vol. xiv, p. 8, 1900.

Limnæa sumassi BINNEY (non BAIRD) L. & Fr. W. Sh. N. Am., p. 43, fig. 58, 1865; TRYON, Con. Hald. Mon., p. 91, 1870.

Shell: Large, generally rather thin, very globose, suboval, inflated; color horny, olivaceous green or rich chestnut; the epidermis is frequently eaten away by the carbon dioxide (CO₂) in the water, and is sometimes streaked as in *emarginata*; nucleus consisting of one and a half chestnut or wine-colored whorls, smooth and rounded and rapidly increasing in size; surface dull or shining, lines of growth fine, wavy, crowded, crossed by numerous fine, impressed spiral lines, giving the surface a delicate texture like network; this is absent, however, in some specimens; frequently, large specimens have a number of raised spiral ridges as in the typical form, and in very old specimens the last whorl is "humped" in several places; whorls 5-5½, convex, inflated, shouldered, the last very large, flaring and strongly shouldered; spire varying from obtusely conic to flattened and much depressed; sutures strongly impressed, deeply channelled in some strongly shouldered forms; aperture very large, flaring, roundly ovate, occupying from two-thirds to three-quarters of the length of the shell, rounded below, and either rounded or square above when strongly shouldered, color varying from deep chocolate to bluish-white; the elevated callus of typical *emarginata* is sometimes present; peristome sharp, thin, generally not flaring as in the typical form; columella white, with a heavy central plait, covered with a callus, and reflected over the umbilicus, which it emarginates;

the columellar callus spreads over the parietal wall; the lower part of the aperture sometimes becomes so distorted that it spreads far beyond the umbilicus. The columellar plait extends clear to the apex, a fact only seen when the shell is cut in sections; this is also true of typical *emarginata*. The juvenile shells are very globose and gracefully rounded, the shouldered whorls only appearing in nearly adult or old individuals.

Length,	15.00;	breadth,	12.00;	apert. length,	10.50;	breadth,	8.50 mill.
"	17.00;	"	12.00;	"	12.00;	"	8.00 "
"	19.50;	"	15.00;	"	13.50;	"	9.50 "
"	19.50;	"	15.50;	"	14.00;	"	10.00 "
"	20.00;	"	15.00;	"	14.00;	"	10.00 "
"	16.00;	"	15.00;	"	12.00;	"	9.50 "
"	25.50;	"	15.50;	"	15.25;	"	11.25 "
"	28.00;	"	18.50;	"	18.50;	"	13.00 "
"	25.00;	"	17.50;	"	17.00;	"	11.50 "
"	25.00;	"	18.00;	"	20.00;	"	12.00 "
"	28.50;	"	19.50;	"	21.00;	"	13.50 "
"	29.50;	"	21.00;	"	21.00;	"	13.00 "
"	27.50;	"	19.50;	"	20.00;	"	12.00 "
"	35.00;	"	22.50;	"	24.00;	"	15.50 "
"	22.50;	"	19.00;	"	17.50;	"	13.50 "
"	25.50;	"	21.00;	"	21.00;	"	15.00 "
"	29.00;	"	23.50;	"	20.00;	"	16.00 "
"	32.00;	"	25.00;	"	24.50;	"	17.50 "
"	35.00;	"	26.00;	"	27.00;	"	17.50 "
"	36.00;	"	29.00;	"	27.00;	"	17.50 "

Distribution: Square Lake inlet, Cross Lake inlet, Aroostook Co., Maine (Olof O. Nylander); Michigan (T. Jensen); Fort Simpson, British America; Isle La Crosse (Binney, p. 31); northern Maine; St. Lawrence River, English River, British America; Hellgate River and Fort Vancouver, Oregon (Tryon in Con. Haldeman, p. 92); Beaver Island, Lake Michigan (B. Walker); Mid Lake, Maine (Morse); Marsh Lake, near Dyea Valley, Alaska (Randolph); Houghton Lake, Roscommon Co., Mich. (Walker); Eagle Lake, Maine (Morse); Brome Lake, Lower Canada (Whiteaves); British America (Binney); Crystal Lake, Benzie County, Mich., (Kirkland vide Walker).

In the variety *mighelsi* variation seems to have reached its limit. Specimens vary from short, oval with moderately depressed spire to very large with short, almost flat spire, and wide, flaring aperture. It is connected perfectly with the short-spined form of *L. emarginata*, as the figures on the plates con-

clusively show. No published figures show the wide range of variation in this species, and the writer trusts that the illustrations of this paper will aid somewhat in the identification of this prolific variety. Unlike some species, this form does not vary according to any particular locality, but the same locality will produce all known variations. A naturalist fond of making species could form not only a large number of species, but several genera. Anatomically the animals show no such variation, but are wonderfully uniform. The surface of the shells vary from perfectly smooth to heavily malleated. The plait on the columella is very strong, and is continued to the apex of the shell, as is well seen in a section.

Specimens recently received from Alaska, sent by Mr. Randolph, are identical with those from Maine, except that they are heavily malleated and show a tendency toward scalari-form monstrosity. In some specimens the aperture runs off at a tangent.

ANIMAL: EXTERNAL APPEARANCE.

PLATE III, figures A, B, C.

Color generally blackish or bluish-black, head, tentacles and the greater part of the body flecked with white or yellowish white, giving the surface the appearance of being covered with a superficial bloom when the animal is in motion, as described by Dr. Whitfield for *Limnæa megasoma* (Bull. Amer. Mus. Nat. Hist., Vol. I, p. 30, 1881). Foot broadly rounded before, more acutely behind, very broad and much flattened on the margins; color bluish-black, lighter beneath and where it joins the body, flecked with yellowish white spots; the center of the sole is lighter than the edge. Head and velum rather short, ranging in form from semicircular to very wide, with the lateral ends obtusely pointed, according as the animal is motionless or rapidly progressing; the vela area is very large in this species, and frequently assumes a bilobate form anteriorly. Mantle large and conspicuous, fitting closely to the aperture of the shell, bluish-black, flecked with whitish or yellowish. Tentacles broad, flat, thin, triangular and very large and conspicuous, obtusely pointed at their extremity, blackish flecked with yellowish white. Eyes black, surrounded by a yellowish-white zone, placed on rather large swellings at the inner bases of the tentacles. Respiratory

orifice placed near the posterior angle of the shell; the so-called "siphon" is capable of great expansion, and when taking in air at the surface of the water is sometimes extended to a length of nearly a third of an inch. The pulmonary cavity fills about half of the body whorl, and is colorless and transparent as seen through the shell, where the heart can also be seen pulsating.

Some animals are lighter than others, the extremes of light and dark being very great. The animal in alcohol is almost jet black, and the spots are sometimes scarcely visible. In a freshly-killed specimen the liver is yellowish-white, with bright yellow patches here and there, but in alcoholic specimens it turns brownish, as seen through the transparent mantle; the edge of the latter is greatly thickened and fleshy, and is made up of the following tissues: an outer thin membrane without cell structure (the *cuticle*); an inner layer of columnar, elongated epithelial cells set on end (the *hypodermis* or *epidermis*); several layers of circular and longitudinal muscles and an inner layer of pavement-like cells (*calomic epithelium*), with very large nuclei (plate IV, figs. I, J).

INTERNAL ANATOMY.

Digestive System (PLATE IV).

Alimentary tract (C). The alimentary tract is similar in general form and structure to the other Pulmonata, differing only in minor details. The mouth (M) is placed at the anterior end of the buccal sac, into which it opens; the buccal sac (P, N) is somewhat pear-shaped when viewed dorsally, and very much so when viewed laterally (P); it is very stout, being composed of strong muscle fibres, and contains the jaw and odontophore (J); the posterior side bears the two buccal or stomato-gastric ganglia (B G); the œsophagus leaves the buccal sac at the dorsal part of the posterior end (O), and passes to the crop in almost a straight line. The buccal sac is bluish in color, and the œsophagus is dark brown or black. Just posterior to the buccal sac the two salivary glands (C, s g) are placed; they are bright yellow in color, irregular or ramose in shape, and are connected with the buccal sac by four ducts (s D) which enter the latter near the œsophagus. A portion of the salivary gland, near one of the ducts, greatly magnified (L x 519), shows a very large number of small blood vessels and tubes, the former appearing black and the latter white.

The region of the stomach is peculiar and was first correctly noted in American *Limnæas* by Dr. R. P. Whitfield (op. cit) in *Limnæa megasoma*. The œsophagus first enters the crop (C, D, E, s), which is an elliptical organ when viewed from the dorsal side, but is pyriform when seen laterally; the stomach follows, and at first lies between two very muscular organs, the bilobed gizzard, and then widens into the pyloric portion which gradually tapers to the intestine. The crop and stomach are yellowish in color while the gizzard is almost black. The latter organ is very large, about the size of a small pea, and composed of two concavo convex portions, almost surrounding the stomach, as described above. They are more or less elliptical in outline, and their extremities are connected by a number of stout fibres of a silvery luster, precisely as recorded by Dr. Whitfield (op. cit). The interior is hard and wrinkled, and much resembles the gizzard of a fowl. The latter is as hard as a pea, but the crop and stomach are soft and fleshy. A number of gizzards were cut open; in freshly killed specimens, which had been in captivity for several months, the gizzards were empty, while in alcoholic specimens they contained particles of siliceous matter. The figure of the digestive system of *Limnæa megasoma* in Prof. Wetherby's article * shows this gizzard, although its correct relation to the crop and stomach is not mentioned. The walls of the stomach, crop and gizzard are made up of long muscle fibres, resembling closely those figured in J. They are all covered with a network of bloodvessels.

The intestine (I) is very long, and is marked by but one pronounced flexure (K, 1); it makes one complete turn after leaving the stomach, then follows the course of the last whorl and a half, bends upon itself, and finds an exit in the anus within the mantle cavity (C, A), not far from the orifice of the vagina. The last part of the intestine is somewhat enlarged to form the rectum (C, R). The liver is very large, filling completely all but the last whorl of the shell, and is dark brown in color. It opens by a number of large ducts into the intestine, and into the pyloric portion of the stomach, and is made up, beneath the epithelial layer, of round liver-cells of varying size, which float in a colorless fluid, the cells being yellowish brown (H). The

* Notes on Some New or Little Known North American *Limnæidæ*, by A. G. Wetherby (Journ. Clin. Soc. Nat. Hist., Vol. II, 1879, p. 96, fig. 1).

pancreas is well developed, but not conspicuous. The liver is well supplied with blood vessels which ramify in every direction, forming a complicated plexus. A pair of blood vessels, one on each side, supply the œsophagus, stomach, intestine, etc., with blood. The intestine is made up of the usual tissues (epithelial lining, vascular, circular, etc.,) which need not be dwelt upon here.

In general, the alimentary tract agrees with the figures published by European authors. The figure of the general anatomy of *Limnæa stagnalis* in Keferstein (taf. ciii, fig. 7) shows this tract very like that of the present species, except that no division into crop, stomach and gizzard is indicated. Moquin-Tandon's figure (pl. xxxiii, fig. 25) of *Limnæa auricularia* is almost identical, but his figure of *L. stagnalis* (pl. xxxiv, fig. 18) differs in the form of the stomach, which does not show the divisions indicated above.

Dr. Whitfield mentions a gizzard-like body in specimens of *L. stagnalis* from Sodus Bay, Lake Ontario, (Am. Mus. Bull., p. 37) which closely resembles that in *L. megasoma*.

The Jaw or Buccal Plate (Pl. iv, fig. M. P. J).

Only one buccal plate was found, and this the large superior jaw. The lateral jaws found in most of the Limnæidæ were apparently absent.* The single jaw is large, very wide and low, the dorsal margin is gracefully arched and smooth while the ventral margin is roughly serrated, with an irregular central projection. The anterior face is striated, and the color is dark brown, almost black in some specimens. Where the jaw joins the supporting ligament it is much lighter in color than is the cutting edge. The jaw is placed in the upper part of the mouth at the extremity of the buccal sac (P, J).

The Radula (Pl. iv, A. B.).

The odontophore is more or less quadrangular in form when spread out, and is about twice as long as wide. There are about one hundred and thirty rows of teeth, each row corresponding to the formula 35-1-35 (6-14-15-1-15-14-6). The central tooth (c) is long and narrow, unicuspid, with the lower outer angles of

*As the lateral jaws are frequently difficult to make out, the writer desires to qualify this remark by adding that he was unable to find any jaws, save the large superior jaw, in any specimen examined, search for the lateral jaws being carried on very carefully.

the base of attachment much expanded and produced. Lateral teeth with a subquadrate base of attachment, the lower outer angle somewhat produced; reflection large, reaching below the edge of the base of attachment, bicuspid, the inner cusp (mesocone) very large, symmetrically rounded and terminating in a sharp point; the outer cusp (ectocone) very small, rather long and narrow, the extremity rather sharp and in some cases pointed inward toward the inner cusp; in several radulæ (A, 2) examined the second lateral had a swelling on the inner side of the inner cusp which probably represented a tendency to form a third cusp (entocone); the intermediate teeth are, for the most part (A, 16, 17, 20, 21), characterized by long and narrow cusps, the base of attachment being short and almost square; they are tri- or penta-cuspid; the teeth first break into tricuspid (16) by the appearance of an inner cusp, which is modified or breaks off from the inner part of the inner cusp, near the distal end; this soon (20) breaks into three cusps, all being at the extreme distal end of the reflection, the outer and inner cusp being of good size with rounded extremities, while the third or middle cusp is very small and sharp or thorn-like; the original outer cusp here breaks into two small, thorn-shaped cusps (20) placed well up on the outer margin; toward the end of the membrane the teeth become very long and narrow, the small inner cusps disappear and the distal ends become 4 or 5-serrate.

A single radula examined (B, 11, 14, 15) had the first intermediate tooth distinctly tricuspid, the endo-, meso and ectocones being as well marked as in the *Helices* (11). The fourteenth tooth had the outer cusp broken into two short, rounded cusps, placed side by side; the fifteenth tooth had three equal cusps at the distal end of the original inner cusp, while the outer cusp was as in the lateral teeth; all of the other teeth were normal. As an example of the *Limnæidæ*, the radula was remarkably constant in the form of the teeth.

Genital System (Pl. III, figs. D. E. F. G).

Male organs (E). As in the *Limnæidæ* generally, the male and female organs are separate (with the exception of the hermaphrodite gland) and open by separate orifices, that of the male being behind the right tentacle and that of the female at the base of the neck, near the pulmonary opening. The penis sack (P. s.) is very large, of great length and large diameter; it is

wide at the exterior opening, but narrow at the end where the penis is attached. The penis (P.) is half the length of the penis sack, very long and slender, with a rounded head, about two and one-half times the diameter of the neck of the penis. The penis and penis sack are retracted and protracted by a set of powerful muscles (RM, PSM). There is a long, hair-like flagellum (F) which extends from the head of the penis to the orifice of the penis sack. A nerve starts from the cerebral ganglion (CG) and after extending for a short distance divides, one branch running to the head of the penis and the other innervating the penis sack (PN, PSN). The penis is generally yellowish in color, sometimes very bright, while the penis sack is grayish (in alcohol) or yellowish (living). The muscles are white in color. The vas deferens (VD) extends from the head of the penis to the columella muscle (CM), where it becomes lost in the muscular tissue; it reappears at the opening of the vagina, where it becomes the duct of the prostate (PD); this duct is rather long, very narrow, and enlarges on the side of the vagina into the prostate gland (PR) a cylindrical, fleshy organ, well supplied with blood vessels, and of a yellowish or amber color. Posterior to the cylindrical portion, the prostate becomes very much narrowed and flattened, whitish in color, and near the albuminiparous gland again enlarges into a much folded organ of a grayish color. From this point the hermaphrodite duct passes to the hermaphrodite gland.

Female organs (D. F. G.). The hermaphrodite gland or ovotestis is made up of a number of rounded or lobulated follicles which have the form shown in figure F when greatly enlarged. The gland is yellowish in color. The ovisperm duct or hermaphrodite duct (OD) extends from the lower part of the ovotestis to the albuminiparous gland, from which it divides, one part forming the prostate and the other the uterus. The albuminiparous gland (AL) is large and rounded, of a greenish color, and made up of quadrangular, pentagonal and hexagonal cells (G), with rather thick walls and filled with granular protoplasm, the granules in the center of the cell being very large. The uterus (U) is at first trilobed, then becomes smaller and rounded, then swells into a large, fleshy, cylindrical sac; the vagina (VA) then contracts to form the vestibule or atrium (A) and finds its exit behind the male orifice and near

the respiratory orifice. The uterus and vagina are yellowish in color and the walls of these organs are made up of strong muscular tissue. The spermatheca or receptaculum seminis (s) is elongate-oval in form, of a pearly white color and connected with the vagina by a long, narrow duct (sd), which enters the latter near the cylindrical portion of the prostate, just above the atrium. The vagina is supplied with two stout retractor muscles (vm). A single nerve (vn) supplies the vagina from the right visceral ganglion. All of these organs are well supplied with blood vessels.

In the natural position the ovotestis is folded in the lobes of the liver and is very strongly attached to that organ. In some works a testicle is described for certain species of the *Limnæidæ*, viz., *L. megasoma* and *Pompholyx leana* var. *solida*, but no such organ could be found in any of the specimens examined, nor is any described in European works.*

Keferstein's figures of the genitalia of *L. stagnalis* (taf. ciii, fig. 8) agrees with that of the present species in a general way, the difference being that that species has no flagellum, the penis sac is shorter, the prostate more bulbous and not cylindrical, and the spermduct enters the atrium lower down. In fact the female genitalia may be said to be longer and more generally cylindrical in the species under discussion than in *L. stagnalis*. Moquin-Tandon's figure (pl. xxxiv, fig. 27) of *L. auricularia* shows the male organ similar, though the penis is not clearly shown and there is no flagellum. The female genitalia is quite different, but this may be because it was drawn from a different position; *L. stagnalis* (pl. xxxiv, fig. 19) is similar to that figured in Keferstein, and shows about the same differences. None of these figures show the innervation of the male and female genitalia. The vas deferens is not shown in Moquin-Tandon's figures as coming directly from the head of the penis, in fact there seems to be no sharp division between the penis and penis sac in the figures of these two species. Lacaze-Duthiers' figure of *L. pereger* (pl. 17, fig. 2) shows the same innervation of male and female genitalia as the present species.

*It is generally conceded that in the androgynous gastropods the ova are borne on the exterior and the spermatozoa on the interior of the individual follicles.

Nervous System (Pl. IV, figs. N, P; pl. V, figs. A, B).

The nervous system is made up of a nervous collar (ganglia) surrounding the œsophagus, just posterior to the radula sac, and a series of nerve cords. The cerebral ganglia lie above the œsophagus and all the other ganglia lie below it.

The *cerebral ganglia* (CG) are situated above or a little to the side of the œsophagus and are joined to each other, to the pedal ganglia and to the pleural ganglia by short, thick commissures. The right cerebral ganglion sends a nerve to the male generative organ which divides before reaching that organ, one branch going to the penis (PNÆ) and the other, which again subdivides, innervating the penis sac (PSN). The cerebral ganglia also send nerves to the tentacles (NT), optic nerves to eyes (ON), nerves to the front of the head (FN), labial nerves to the region of the mouth (LN), and a pair of nerves to the buccal sac. These latter or cerebral commissures (CC) enlarge on the buccal sac to form the buccal (BG) or stomato-gastric ganglia. These ganglia send out a number of small nerves which innervate the buccal sac and the manducatory organs (pl. IV, figs. N, P). Branches are also sent to the salivary glands.

The *pedal ganglia* (PG) are very large, lie directly beneath the œsophagus, and are connected with the cerebral and pleural ganglia by short, thick commissures. These ganglia send off two sets of nerves of three each, the first, inferior and superior cervical and columellar nerves (IC, SC, CN) to the posterior part, and the second, superior, inferior and central pedal nerves (IP, CP, SP) to the anterior part of the foot. There are several other short, minute nerves whose functions are unknown to the writer. The otocysts (OT) are placed in the posterior part of these ganglia, and are connected with some of the other ganglia by fine nerves.

The *pleural ganglia* (LG) lie below the œsophagus, and are connected by short, thick commissures with the pedal, cerebral and visceral ganglia. They apparently send off no nerve cords.

The *visceral ganglia* (VG) lie behind, a little above the pleural ganglia, and are connected with the latter and the abdominal ganglia by short commissures. The right ganglion sends off a long nerve (v' right pallial nerve) which innervates the female genital orifice, a portion of the respiratory cavity and

the right posterior part of the mouth. Near the end of this nerve an enlargement forms the olfactory organ or osphradium (os). A shorter nerve (v, anterior pallial), leaves this ganglion near the one spoken of, and shortly joins a similar one from the abdominal ganglion, the combined nerve passing to the vagina, the anterior part of the mantle and the respiratory cavity.

The left ganglion sends off a single long nerve which innervates the mantle along its sides (L M).

The *abdominal ganglion* (A G), which is really two ganglia fused together, lies behind and somewhat below the visceral ganglia, is connected with the latter by two short, thick commissures, and sends off four nerves. One of these has already been described under the right visceral ganglion. The central nerve (s 1) is the longest and innervates the pericardium, aorta, part of the genitalia, the rectum, kidney and respiratory cavity. A somewhat shorter nerve on the right of this (A) furnishes nerve force to the posterior part of the aorta and a part of the genitalia. To the left of the central nerve a small nerve supplies the anterior part of the mantle. The nerves of the abdominal and visceral ganglia also innervate different portions of the digestive system.

In a living specimen the ganglia are of a very bright orange color, but in alcoholic specimens they are yellowish or yellowish white. The eyes are as usual in androgynous Pulmonata. The sclerotic membrane, choroid, cornea, etc., are well developed, and the optic nerve is very large.

In working out the foregoing, Lacaze Duthiers' article in *Archiv. de Zool. Exp.*, has been followed as a guide. The nervous system of the present species may be said to be almost identical with that of *Limnæa pereger* described and figured by Lacaze Duthiers (pl. 17, fig. 2). Spengel's figure of *L. stagnalis* is also the same (taf. xvii, fig. 11), excepting that the nerves to the penis and vagina are not shown. Moquin-Tandon's figures are different, his *Limnæa palustris* (pl. 34, fig. 27) showing a fused condition of the abdominal and visceral ganglia. In his figure of *L. auricularia* the pleural and visceral ganglia appear to be fused and the nerves are insufficiently shown. No figures, excepting Lacaze Duthiers', show the peculiar innervation of the male and female genitalia.

Circulatory System (Pl VI; pl. IV, figs. F, G; pl. III, figs. H, J).

The heart is on the left side of the animal, at the apex of the respiratory cavity, and lies laterally between the œsophagus and the rectum, and not far from the stomach; it is also between the anterior portion of the liver and is bounded on the right by the kidney. The ventricle and auricle lie in a large oblong pericardium (PE, A, v); a large aorta which leaves the ventricle soon divides into two main branches the *aorta cephalica*, which supplies the œsophagus, stomach, intestines, etc., and the *aorta visceralis*, which supplies the liver and hermaphrodite reproductive organs; this branch splits into two main branches (RV, LV), one going to the liver and the other to the sexual organs.

The *aorta cephalica* extends from the ventricle to a point about the middle of the left crop, where it splits into four main branches, two anterior and two posterior, one pair passing down each side of the œsophagus and the other down each side of the intestine and rectum and finally uniting with the branchial plexus (pl. vi, LVO, ILV, G). From the four main branches about the stomach, several large branches are given off, which in turn imbranch, forming an arborescent plexus over the stomach, crop and gizzard. The lateral vessels of the œsophagus and intestine also form plexuses over both of the latter organs, and two large branches are given off for the salivary glands (s). A complicated plexus is formed over the buccal sac (B), and here the lateral vessels send branches to the eyes, tentacles, penis and two large branches to the foot (E, T, F, P). The branch to the penis divides, forming two main branches, which imbranch many times, forming a plexus over that organ.

One branch of the *aorta visceralis* (RV) supplies the hermaphroditic reproductive organs and divides into four main branches on those organs, one branch supplying the ovotestis (OV), another the oviduct and vagina (VA), another the prostate (PR), and still another the receptaculum seminis. All of these branches subdivide many times and form plexuses over these organs.

The second branch of the *aorta visceralis* is very long and supplies the liver (LV). In this organ there are three main branches, each with several smaller branches, which in turn imbranch to form a dense network or plexus (LI).

The mantle is supplied with a plexus of fine bloodvessels which collect the blood into two large veins, and several smaller ones (M) and which finally unite with the branchial artery (BA). There are no veinous capillaries present, the blood flowing freely about the cœlomic cavity and being collected in the two veins, as already explained.

The writer has been unable to find any reference to the two lateral vessels of the œsophagus and intestine in any work, most figures showing but one vessel. These two vessels were found in all the specimens examined in the position shown in the figures. A cross section of the intestine shows these branches to be true lateral vessels, placed very much like the dorsal and ventral vessels in the earthworm (pl. iii, H). Dorsal and ventral branches (BLV, pl. iii.) are given off which imbranch to a most wonderful degree, forming a typical plexus (pl. iii, J; see also pl. iv, F, G). The arteries and veins were almost black in freshly killed specimens, but the blood itself appeared uncolored.

The circulation does not differ materially from that of any of the Pulmonata, and is similar to the descriptions and figures in Keferstein and Leidy, with the exception of the two lateral vessels of the œsophagus and intestine.

Respiratory System (Pl. III, fig. I; pl. VI).

The respiratory cavity or lung occupies nearly half of the last whorl, when dilated (pl. iv, L). It is longer than wide, and is supplied with a network of blood vessels, forming small fossets (pl. III, fig. I). These connect with the branchial artery, which conducts the æriated blood into the auricle and from this organ to the ventricle. The respiratory cavity is situated on the right side of the body and is closed by a lobe of the mantle, which forms a sort of siphon.

This species does not seem to require oxygen frequently, if one can judge by its actions in captivity. Several specimens confined in a large glass of water visited the surface about three times daily.

Renal System (Pl. VI, K, U).

The kidney lies on the right side of the pericardium, and is a long, cylindrical organ with hard, muscular walls. A ureter (U) leaves the posterior end of the kidney and has its exit not far from the anus. The kidney is covered with a plexus of blood

vessels, which open into it in several places, thus allowing the urinary products to mix with the blood. The structure of the kidney is as usual in the Pulmonata.

Muscular System (Pl. III, figs. D, E; pl. IV, figs. O, P, Q).

Besides the columella muscle and the muscular tissue forming the walls of the different organs, there are a number of free muscles of great importance. These are the retractors of the sexual organs and also of the tentacles and buccal organs. The buccal retractors (pl. IV, fig. P, Q) are two in number and are attached to the columella muscle. The retractors of the tentacles (one for each) are rather wide bands, and are also attached posteriorly to the columella muscle (pl. III, O).

The retractors of the genital system are nearly all attached to the diaphragm or floor of the lung. The penis retractor is a long, ribbon-like band of muscle with one end inserted in the base of the penis and the proximal end inserted in the columella muscle. The penis retractor has a short branch, which leaves it about the middle, and is inserted in the upper part of the penis sac by means of a number of small muscles produced by the splitting up of the main muscle. The penis sac is supplied with three protractors, the distal insertions (on the penis sac) splitting once, and these in turn again, making four separate insertions for each muscle. Two muscles are inserted near the lower part, and one near the middle of the penis sac. (Pl. III, RM, PSM).

The vagina is supplied with two retractor muscles, similar in form to those of the penis sac, the distal insertions (on the vagina) being three in number caused by splitting as described for the penis sac, and inserted, one on the lower part and one near the center (pl. III, D, VM).

The retractors of the foot are attached to the columella muscle, as in most spiral shells.

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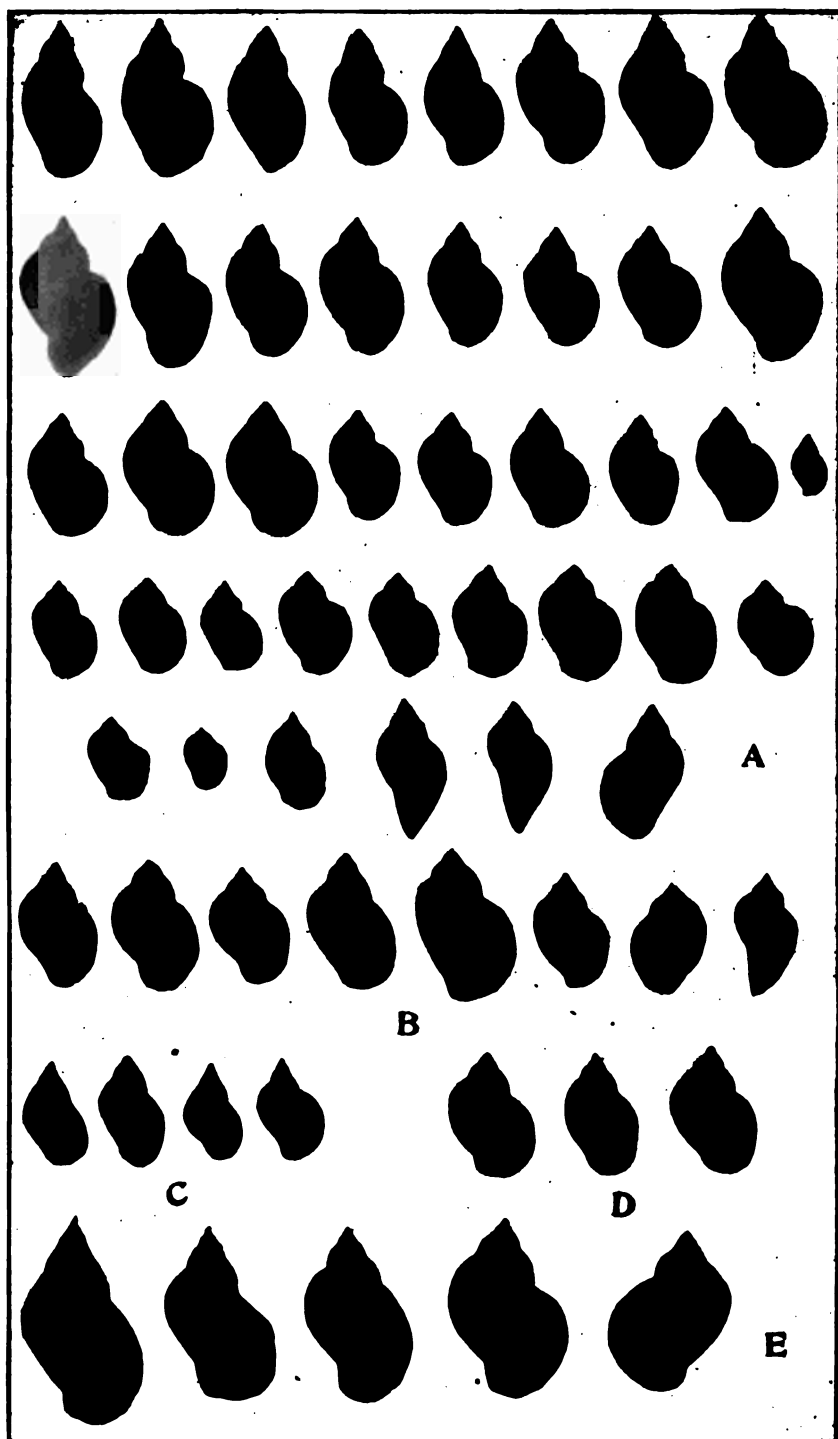
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EXPLANATION OF PLATE I.

- A. *Limnæa emarginata* SAY, from Owasco Lake, Cayuga Co., N. Y., showing variation from the long to the short-spined form. (Dr. H. N. Lyon.)
- B. The same from Aroostook River, Caribou, Aroostook Co., Maine, (O. F. Nylander.)
- C. The same from Pigeon Lake, Ontario Province, Canada. (Geo. H. Clapp.)
- D. The same from First of Four Lakes, Madison, Wisconsin. (P. P. Carpenter.)
- E. The same from Owasco River, Cayuga Co., N. Y. (Dr. H. N. Lyon.)

PLATE I.



EXPLANATION OF PLATE II.

Showing variation of shells of *Limnæa emarginata* SAY, variety *mighels*, Binney, from the form with elevated spire and narrow aperture to that with a short spire and wide, spreading aperture. All from Cross Lake, Aroostook Co., Maine. (Olof O. Nylander.)

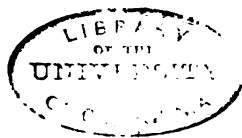
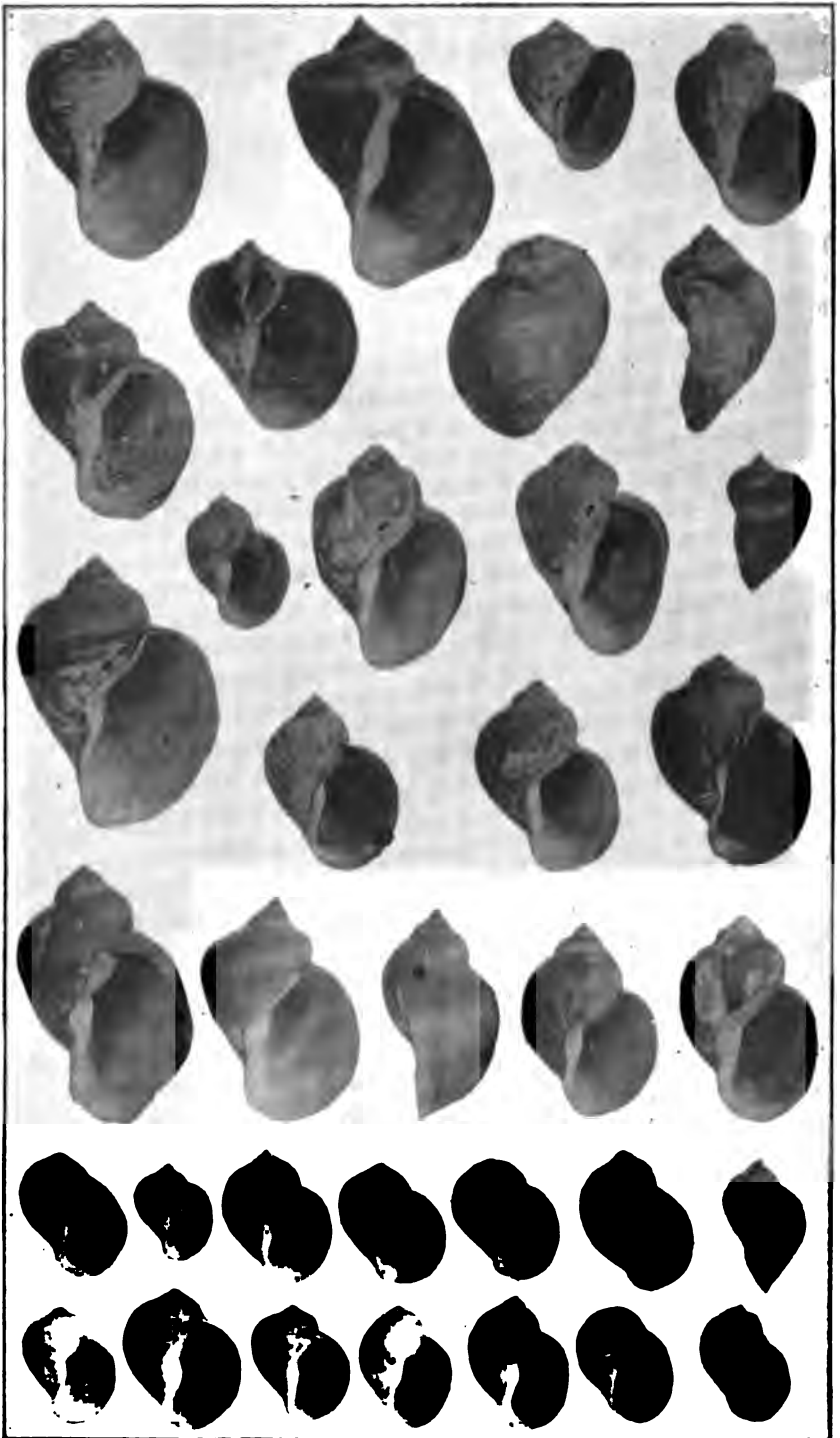


PLATE II.

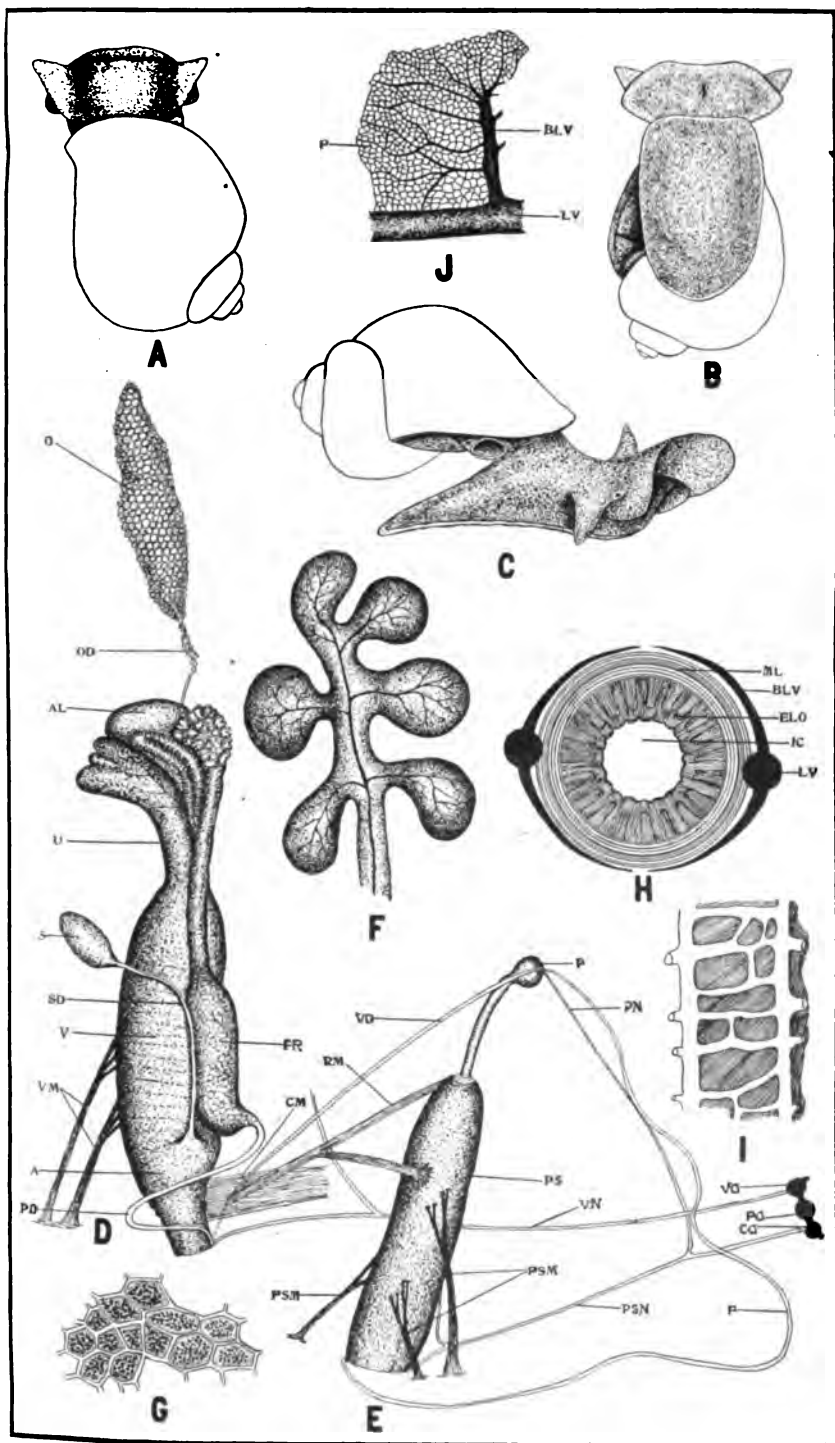


EXPLANATION OF PLATE III.

- A. B. C. Animal of *Limnæa emarginata* SAY, var. *mighels*, Binney.
A, from above; B, from below; C, from the right side, showing extended velum.
- D. Genitalia (principally female).
A, atrium or vestibule of vagina; AL, albuminiparous gland; O, ovotestis; OD, ovisperm duct; PD, duct of prostate gland; PR, prostate; S, spermatheca or receptaculum seminis; SD, duct of spermatheca; V, vagina; VM, retractor muscles of vagina; U, uterus.
- E. Male organs.
CG, cerebral ganglion; CM, columella muscle; F, flagellum; P, penis; PG, pleural ganglion; PN, nerve to penis; PS, penis sac; PSM, penis sac protractor muscles; PSN, penis sac nerve; RM, retractor muscle of penis; VD, vas deferens; G, visceral ganglion; VN, nerve to vagina.
- F. Portion of ovotestis, showing blood vessels (x 519).
- G. Cells from the albuminiparous gland (x 519).
- H. Diagramatic section of intestine; BLV, branch of lateral blood vessel; ELO, epithelial layer of œsophagus; IC, intestinal cavity; LV, lateral blood vessel; ML, muscular layer of œsophagus.
- I. Portion of lung, showing two main vessels and several connective vessels (x 519).
- J. Portion of lateral blood vessel with one branch with its connective plexus (x 519).



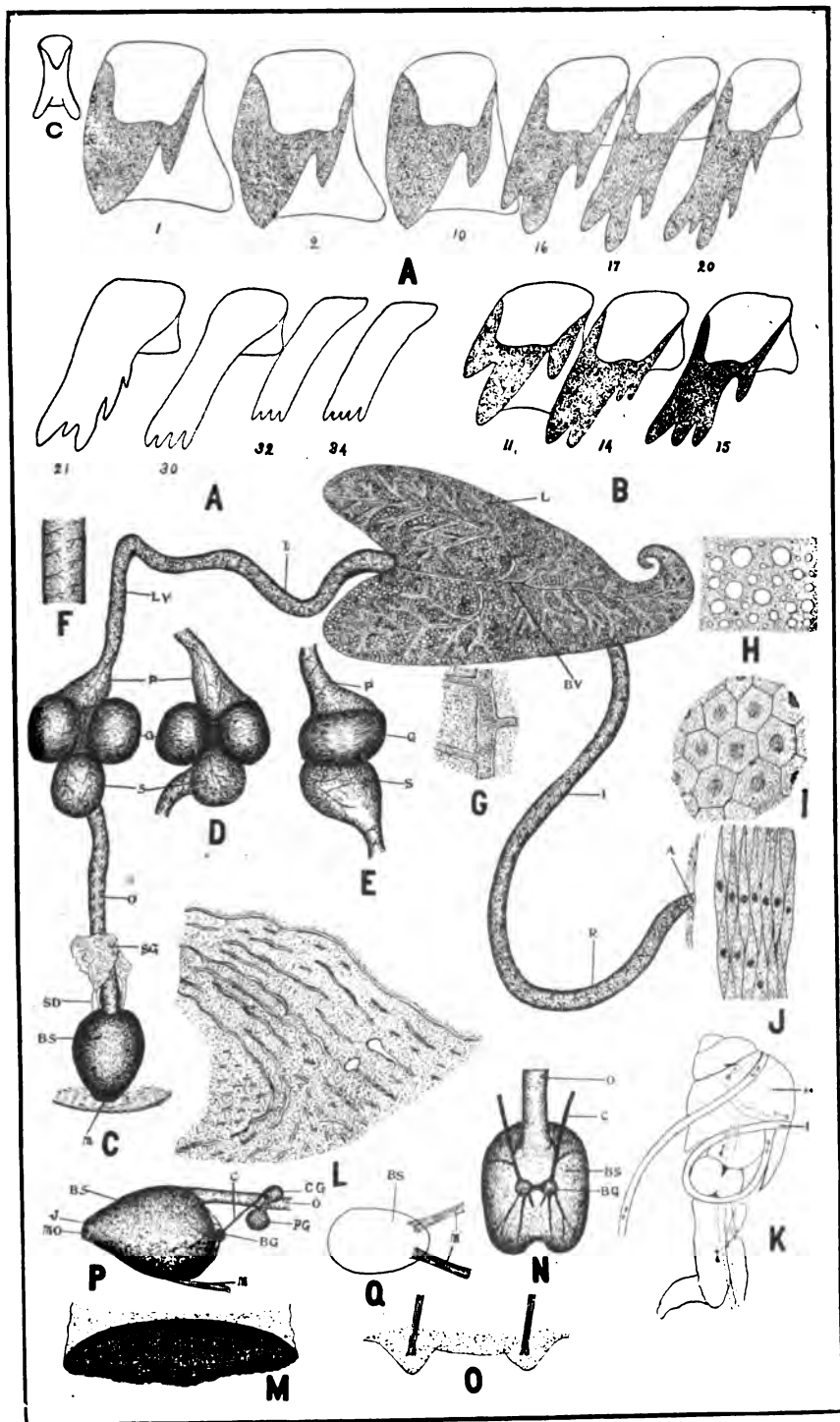
PLATE III



FRANK C. BAKER, del.

EXPLANATION OF PLATE IV.

- A. Radula; C, central tooth; 1, first lateral; 2, second lateral; 10, tenth lateral; 16, transition tooth; 17, 20, 21, 30, marginal teeth; 32, 34, extreme marginals.
- B. Radula of another specimen; 11, eleventh lateral; 14, transition tooth; 15, first marginal.
- C. Digestive system, seen from above, the intestine and liver turned to the right. The whole system is dissected and spread out (see K); A, anus; BS, buccal sac; BV, blood vessel of liver; G, gizzard; I, intestine; L, liver; LV, lateral blood vessel; M, mouth; O, oesophagus; P, pylorus; R, rectum; S, crop; SG, salivary gland; SD, duct of salivary gland.
- D. Stomach, crop and gizzard from below; lettering same as C.
- E. Stomach, crop and gizzard from the left side; lettering as in C.
- F. Portion of intestine showing lateral blood vessel, one on each side (x 100).
- G. Portion of intestine showing lateral vessel and three branches (x 200).
- H. Cells from the liver (x 519).
- I. Coelomic epithelial cells of mantle (x 519).
- J. Connective muscle cells from mantle (x 519).
- K. *Limnæa mighelsi* partly dissected to show natural position of intestine. L, liver; I, intestine; —> indicates the natural course of the intestine from mouth to anus.
- L. Portion of salivary gland near duct, showing numerous blood vessels (x 519).
- M. Jaw.
- N. Buccal sac, viewed from the posterior end, the oesophagus turned forward; BG, buccal ganglion of left side; BS, buccal sac; C, connective nerve between buccal ganglion and cerebral ganglion; O, oesophagus.
- O. Tentacles, showing retractor muscles.
- P. Buccal sac, viewed from the left side. BG, BS, C and O as in fig. N; CG, cerebral ganglion; J, jaw; M, retractor muscle; MO, mouth; PG, pedal ganglion.
- Q. Buccal sac viewed from below and turned forward; lettering as in P.



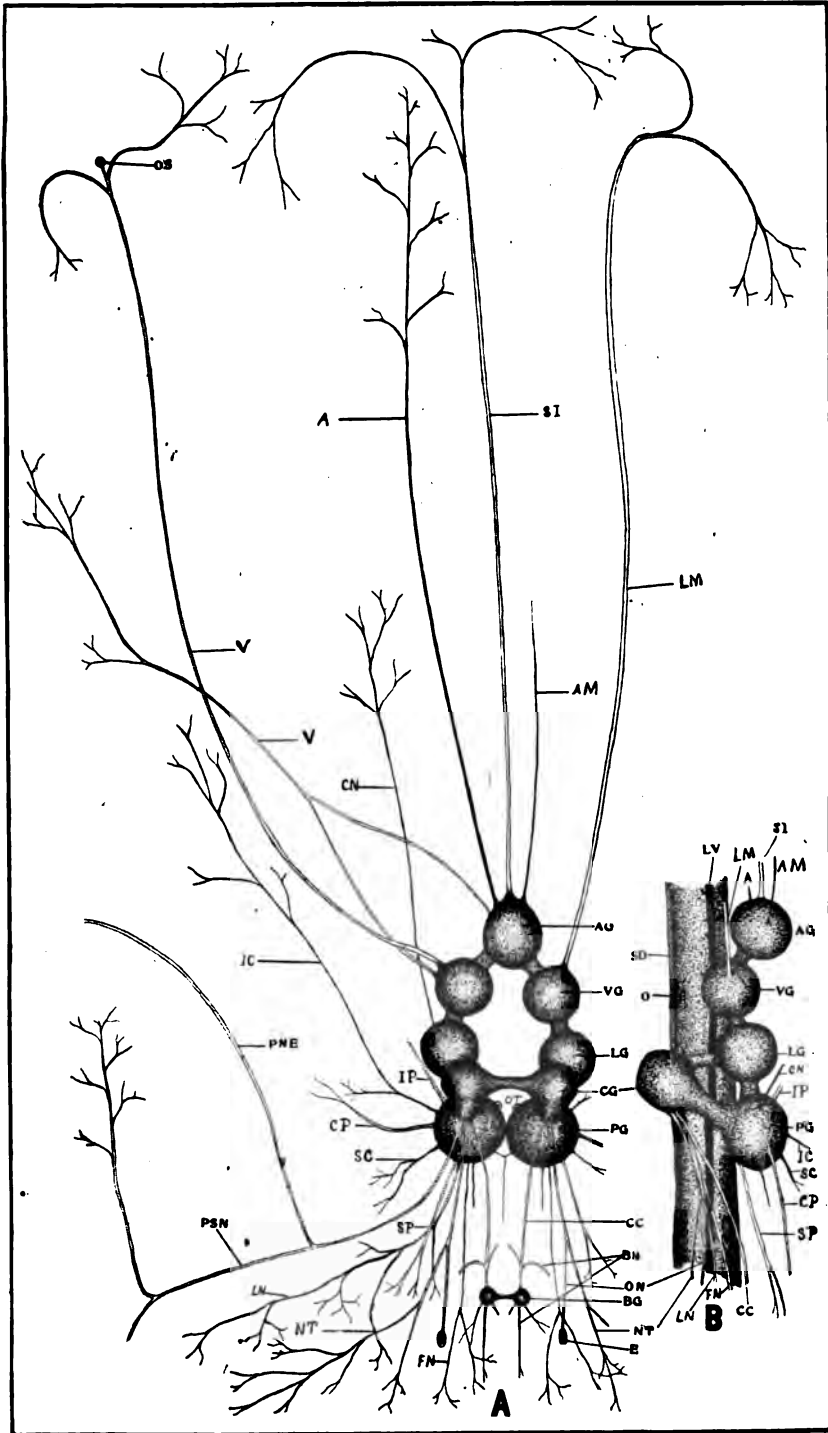
EXPLANATION OF PLATE V.

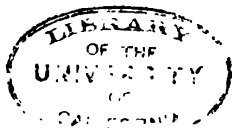
A. Nervous system viewed from above.

B. Same viewed from the left side.

A. Aortic nerve. AG, abdominal ganglion; AM, anterior mantle nerve; BG, buccal ganglion; BN, buccal nerves; OC, cerebro-buccal connective; CG, cerebral ganglion; CN, columella nerve; CP, central pedal nerve; E, eye; FN, frontal nerve; IP, inferior pedal nerve; IC, inferior cervical nerve; LG, pleural ganglion; LN, labial nerve; LV, lateral bloodvessel; LM, lateral mantle nerve; NT, tentacular nerve; O, oesophagus; ON, optic nerve; OS, osphradium; OT, otocysts; PG, pedal ganglion; PNE, penis nerve; PSN, nerve to penis sac; SD, duct of salivary gland; SC, superior cervical nerve; SP, superior pedal nerve; SI, genital nerve; VG, visceral ganglion; V, anterior pallial nerve; V, right pallial nerve.

The left visceral ganglion is a trifle too large in the figures. Only the nerves in the right side are shown for a part of the nervous system, where they are duplicated on the opposite side.

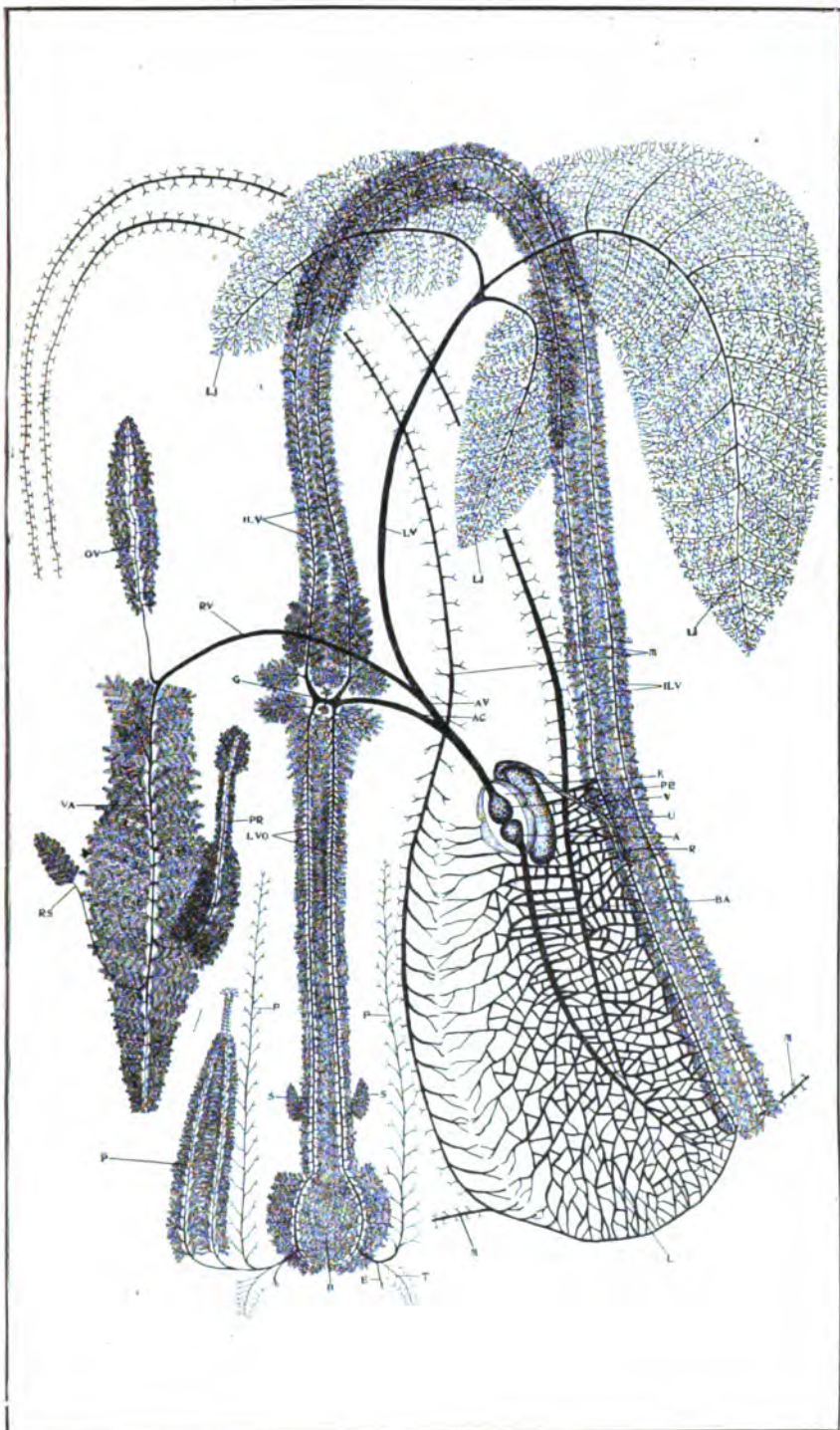


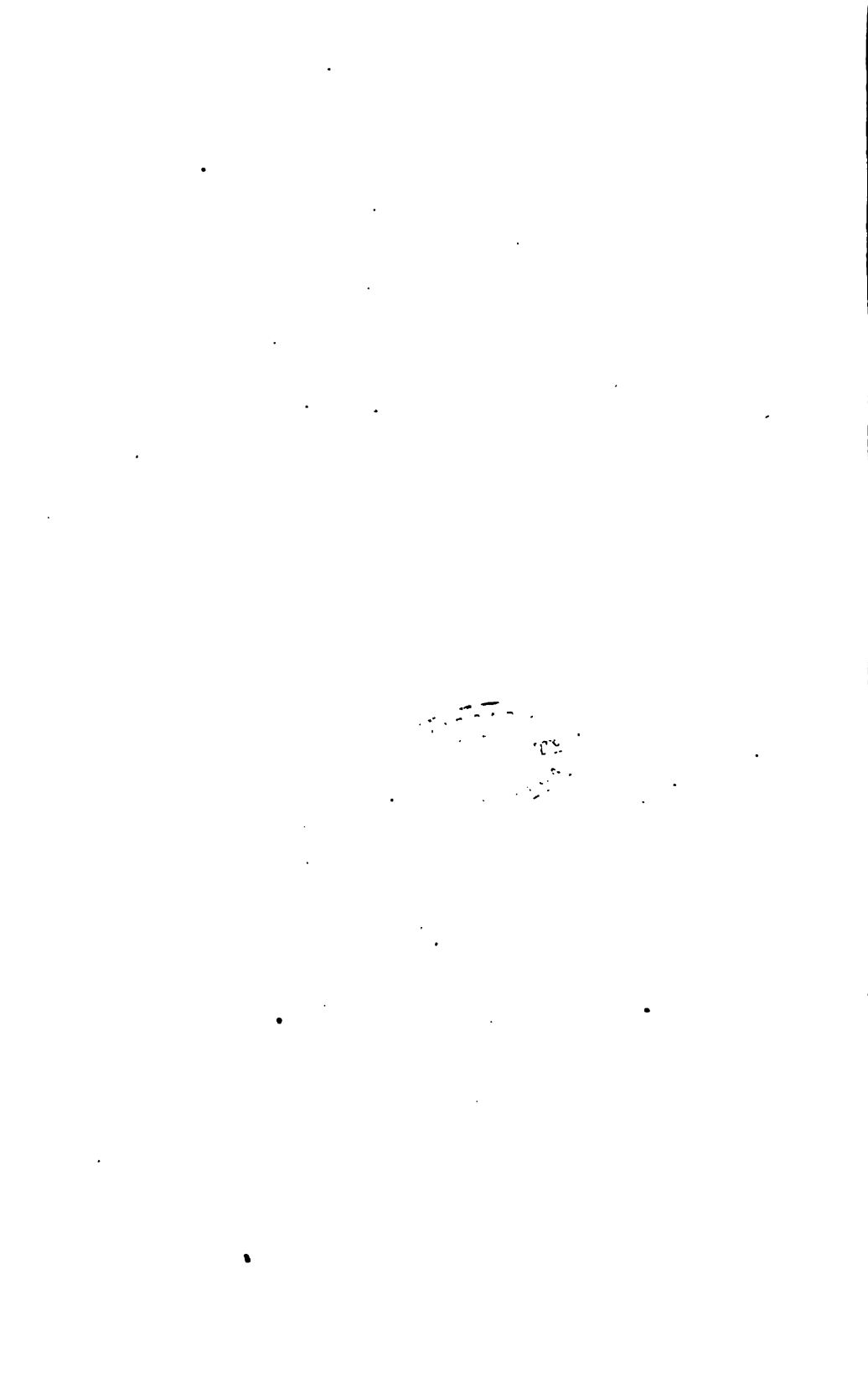


EXPLANATION OF PLATE VI.

- A. Auricle.
- AC. Aorta cephalica.
- AV. Aorta visceralis.
- B. Plexus covering buccal sac.
- BA. Branchial artery.
- E. Vein to eye.
- F. Pedal artery.
- G. Artery from aorta cephalica which sends branches to gizzard, stomach, intestine, etc.
- ILV. Lateral vessels of intestine.
- K. Kidney.
- L. Lung.
- LI. Blood vessels of liver.
- LV. Artery from aorta visceralis to liver.
- LVO. Lateral vessels of oesophagus.
- M. Mantle veins.
- OV. Vessels of ovotestis.
- P. Vessels of penis sac and penis.
- PE. Pericardium, cut open.
- PR. Vessel of prostate gland.
- R. Rectum.
- RS. Vessel of spermatheca.
- RV. Artery to reproductive organs, from aorta visceralis.
- S. Vessels of salivary glands.
- T. Vessel of tentacle.
- U. Ureter.
- V. Ventricle.
- VA. Vessels of vagina.

This plate shows the circulatory system as seen from above, the heart, lung and rectum turned over to the left (hence the lower side is presented), as well as the liver. The arteries and their vessels are represented as though dissected and spread out to show the plexus which they form. The branch of the aorta visceralis, which supplies the generative organs, is represented considerably longer in the figure than it is in nature, this lengthening being necessary to show the branches of the circulatory system.





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No. IV.

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....OF....

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1. The Digitations of the Mantle in Physa.
2. Description of a New Species of Limnæa.

..BY..

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ISSUED JULY 1, 1901



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BULLETIN OF The Chicago Academy of Sciences.

I THE DIGITATIONS OF THE MANTLE IN PHYSA.

FRANK COLLINS BAKER.

If the edge of that part of the mantle of *Physa* which is reflected over the parietal wall is examined, it will be found to consist of a greater or less number of little finger-like digitations and the fact will also be noted that these projections are placed in two series, one near the umbilical region and one at the posterior extremity of the aperture, a simple or smooth space of the mantle edge connecting and lying between these two series. A more detailed examination will show that the form, number, and general position of the digitations vary in a wonderful degree in different individuals of the same species. In the present paper several of our common species are discussed.

American literature contains but few references to the digitate mantle of *Physa*. Haldeman says,* "Inner and posterior edge of the mantle-digitate." Binney says,** "Mantle covering part of the shell, the margin fringed or digitate." Thomas Say, whose careful delineation of species is unsurpassed in American conchological literature, says of the animal of *heterostropha*:† "The mantle is trifid at the base of the pillar lip and at the upper corner of the aperture.

These references show that little or no attention has been paid to the study of this part of the animal.

The material upon which this paper is based was personally collected in Providence, R. I., Rochester, N. Y., and Chicago, Ill. Many specimens have been examined, including individuals of all ages. The writer has been struck with one fact which stands out prominently, that the species with shell exhibiting little or no variation, as *Physa integra*, had the marginal digitations very uniform, while in those species subject to great variation, as *Physa gyrina*, there was a corresponding variation in the mantle margins, which fact shows that the shell and animal are correlated as to variability.

* A Monograph of the terrestrial Univalve Mollusca of the United States, *Physidæ*, p. 29, 1842. Tryon, Contr., p. 125.

** Land and Fresh Water Shells of North America, part II, p. 75, 1865.

† Binney, Land and Fresh Water Shells of North America, p. 24.

The writer is indebted to the following persons for assistance in either notes or specimens: Mr. Bryant Walker, Detroit, Mich., and Mr. Harry S. Hall, Rochester, N. Y.

In the following descriptions the region of the posterior part of the aperture will be termed the apex and the columella region the columella.

Physa integra Haldeman, pl. 1, A, B.

The mantle margins of this species are very uniform. The normal form has 3 rather long, narrow digitations at the apex and 4 in the columella region (B). About two per cent. of the specimens examined had 5 digitations in the columella region and 3 at the apex (A). A very small percentage had 4 short digitations at the apex and in one or two specimens the apical digitations were very small or wanting. Over fifty specimens have been examined.

Physa integra is common in the Erie Canal and Genesee River, where it is very uniform. The white, thickened lip of this species is very characteristic, and the majority of specimens have the various rest periods marked as white longitudinal stripes on the older whorls of the shell. When alive the white lip is the most conspicuous part of the animal.

Physa gyrina Say, pl. 1, C to I, L to O.

As might be expected, the mantle margins vary more in this species than in any other member of the genus which has been examined, thus being coördinate with the variation in the shell. The normal form appears to have 4 long, narrow, equal apical digitations, and 6 in the columella region, the latter having central projections somewhat longer than those on either side, as shown in figure M. From this type the variation is almost endless. The digitations at the apex vary from 2 (I) to 5 (M), and any one of the projections may be short and stumpy (H) or very long and slender (L); or the entire apical portion of the mantle may be made up of 4 small, rounded knobs (C). The digitations in the columella region are also very variable. The smallest number seen was 4, small and finger-like (C), and the largest 10, of which 5 were very large and long and 5 were very short, 2 on one side and 3 on the other (N). Several specimens examined had 6 columella digitations, in which there were 2 long projections with a small tubercle on each side (L).

Another variation, seen in several specimens, was 3 large and 3 small digitations (G. O.), and in a number of individuals the number was 8, all of which were nearly equal (F).

The greatest variation was found among specimens from the Genesee River and the Erie Canal. Several specimens from Providence, R I., were very uniform, the extremes of variation being apex 2, columella 5 (I), and apex 5, columella 6 (H). Mr. Bryant Walker finds the Michigan *gyrina* to vary as follows: apex, 4 to 5; columella, 3 to 6. The numerous figures on the first plate show the extremes of variation, both in number and form.

Physa heterostropha Say, pl. I, J, K.

This species does not exhibit the variation shown in either *gyrina* or *sayii*. The normal form has 4 digitations in the apical and 5 in the columella region. The apical projections vary from 3 to 4, and the columella from 4 to 6. The digitations are very uniform in size, being rather long and tapering.

Judging from the writer's experience in Physæ, *heterostropha* is quite rare, instead of being very common, as is generally reported. No undoubted specimens have been seen from Rhode Island, and in western New York it is rare, as is also the case in northern Illinois. It should be borne in mind that the shell of *heterostropha* is smooth, while that of *gyrina*, *sayii*, and others is encircled by fine, impressed, spiral lines.

Physa sayii Tappan, pl. 2.

Although the shell is quite uniform in *sayii* the mantle margins show a wide range of variation. The normal form has 4 apical digitations and 5 columella digitations (H). The former vary from 4 to 5 and the latter from 4 to 8. In form they are mostly long and tapering, although a few are short and stumpy, as in B. One specimen had a split digitation in the columella region (H), and several specimens had all the projections very small, rounded, and stumpy (G). The plate shows these variations sufficiently.

Physa vinosa Gould.

Mr. Bryant Walker has given me the following data for this species: The digitations were longer and more slender than in *gyrina*; four out of six examples had 5 columella digitations and two had 4 columella digitations, while four specimens had the apical digitations 3, and two had 4.

***Physa traskii* Lea.**

Specimens of this species recently collected by Mr. Frank M. Woodruff, at San Diego, Cal., exhibit the following variations: apical digitations 3, 4, 5; columella 5, 6, 7, 8. The digitations are generally very uniform, long and tapering, but occasionally the variation in size is considerable, as in the figure of *sayii* on plate II, figure E.

When the writer began these investigations he hoped that in them he would find some help in drawing specific lines in this very variable family. Such has not been the case, however, for nearly all of the species vary greatly and all seem to have about the same range of variation. It was thought that the digitations were, in a measure, able to contract and expand, but there is not evidence enough as yet to establish this as a fact beyond question. Several species appeared to have this power over the digitations of the mantle. This is a subject for future investigation.

COMPARATIVE TABLE OF VARIATION.

Integra.			Gyrina.			Heterostropha.			Sayii.			Traskii.			Vinos.		
A*	C	N	A	C	N	A	C	N	A	C	N	A	C	N	A	C	N
0	4	2	2	4	4	3	4	4	4	4	7	3	5	2	3	5	4
3	4	49	2	5	1	4	5	14	4	5	27	4	5	6	4	4	2
3	5	3	3	4	4	4	6	2	4	6	6	5	6	2			
4	2	2	3	5	6				4	8	2	5	7	1			
4	3	2	3	6	8				5	6	2	5	8	1			
4	4	2	4	4	20				5	7	3						
			4	5	25				6	6	3						
			4	6	100												
			4	7	10												
			4	10	6												
			5	4	11												
			5	6	25												
			5	8	30												
60			250			20			50			12			6		

* A=anterior; C=columella; N=number of specimens examined.

2 DESCRIPTION OF A NEW SPECIES OF LIMNÆA.

FRANK COLLINS BAKER.

Limnæa woodruffi sp. nov. Text figure.

Shell: Ventricose, very much inflated, solid; color greenish horn or olivaceous; surface shining, growth lines distinct; rough in some specimens, crossed by numerous fine impressed spiral lines; apex small, rounded, light horn colored; whorls 3-4, rounded, inflated, the last occupying nearly the whole of the shell; spire depressed; sutures impressed; aperture very large, roundly ovate, occupying about four-fifths of the length of the entire shell, roundly shouldered at the upper part; peristome thin, sharp; columella thickened, spreading, with a plait or fold in the middle; the lower part of the aperture is expanded, the columella callus making a ridge which is reflected over the umbilical region; umbilicus open, deep.



Length 12.50; width 8.00; aperture length 8.50; width 5.50 mill.

Length 11.00; width 8.00; aperture length 8.00; width 5.00 mill.

Length 11.50; width 8.00; aperture length 8.00; width 4.75 mill.

Animal, Jaw, Radula and Genitalia: Not examined.

Distribution: Southern part of Lake Michigan.

Habitat: Probably similar to *catascopium* and *emarginata*.

Remarks: This species has puzzled the writer for many years and has been referred to both *decollata* and *catascopium*.*

It certainly is not any form of *catascopium*, and, judging by the figures in Binney, Haldeman and Tryon, it is not *decollata*. Specimens of the latter received from the Philadelphia Academy of Sciences are decidedly different, the spire being longer, the

*In the writer's paper on the *Limnæa* of Northern Illinois, in Trans. St. Louis Acad. Sci., Vol. IX, No. 1, pl. 1, fig. 12, this form was referred to variety *pinguis* Say. The receipt of a large number of specimens has demonstrated that it is not that form.

number of whorls less and the shape of the aperture is dissimilar. The principal characteristics of *woodruffi* are its very short spire, rapidly increasing and swollen whorls, and its roundly oval aperture with its broad shoulder at the upper part. It looks not unlike a miniature *Limnæa emarginata*, variety *mighelsi*. The present species has been described as new for the reason that in a lot of some two hundred specimens no individual has been found connecting it with any known form. It has been found at Millers, Ind., and along the lake shore in Chicago, by Mr. Frank M. Woodruff, to whom the species is dedicated.

PLATE I

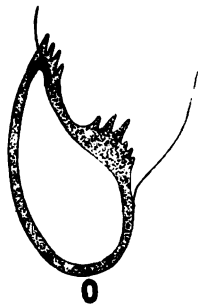
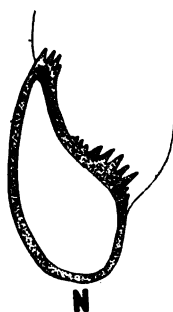
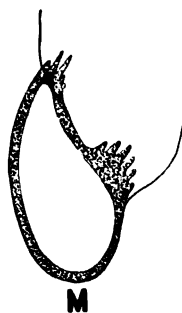
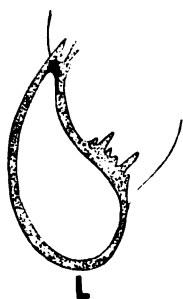
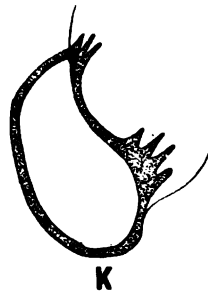
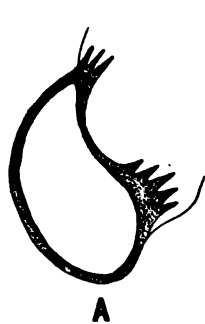
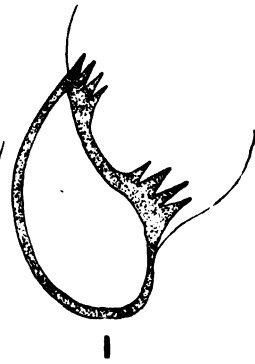
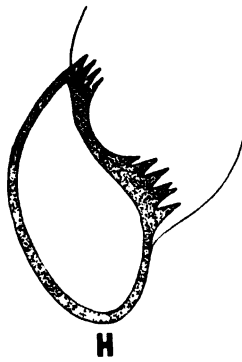
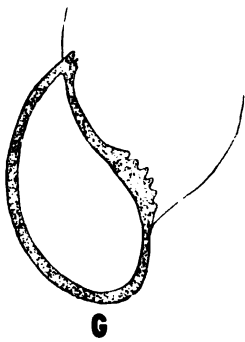
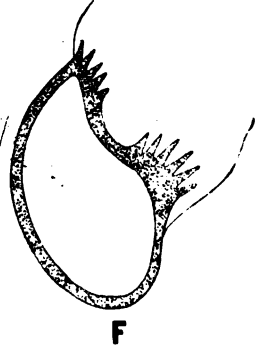
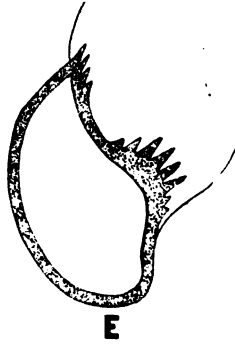
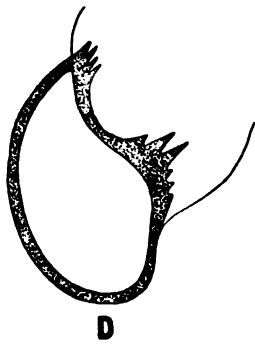
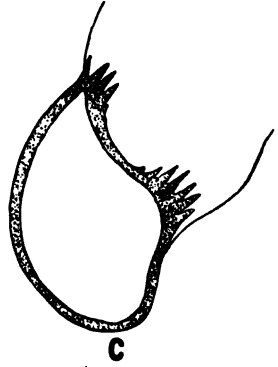
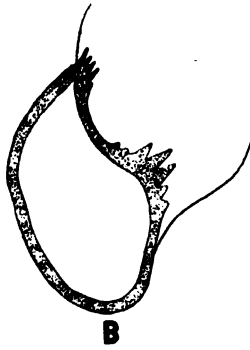
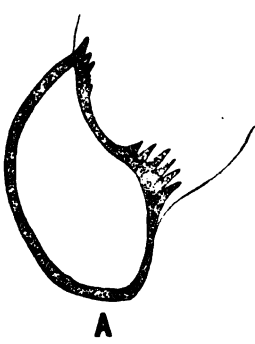




PLATE II.





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